Notes on education

R. B. Gregg.

1926.

Schedule

week days.	10 - 10.44	Math	2 periods
	12.20 - 1.26	Science + math	3 periods
Saturday	10. - 10.22	Math	
	11.10 - 11.43	Science	

Re mathematics for palaia.

Proceed from known to unknown. Illustrate principles and methods by problems involving spinning, weaving, wool shearing, shepherding, field measuring, maps, trail & road making, bridges, height of trees & of cliffs, & of hills & of houses. ladders, landslides, application of manure, sale or shearing of fruit, drying of fruit, handmills, water wheels, chupatis making, providing for feasts & melas, crop yields, qualities inherited by cattle, village census, mortality census, pottery, basketry, carpentry, masonry, cutting out clothes, shapes of caps, hues, firewood, burning, water carrying, water vessels, house problems

From such examples can be illustrated the principles of addition, subtraction, multiplication & division; fractions; practise; ratio & proportion; etc.

Such illustrations may also used in algebra

and in physics and chemistry.

Others might be taken from flight of birds, beams, fire, cooking, properties of soap, of fruits, of dyestuffs, of wood & stone & metal. Climbers. pulley wheel. Bunyan's dealings with Sinclair, forty camels, wool buying at Rampur.

Prof Khuda Ram says that usual practice is to begin algebra in 7th form. He advises giving physics before chemistry. Give them the last two years.

Give a short synthesis once a week in terms (1) of that week's work alone in that subject (2) of that week's work in relation to (a) other school subjects, (b) their home & village & country life & surroundings, (c) their future (d) their Indian spiritual culture.

Try to give them a sense of control of their lives & of affairs & of the future, a sense that nature works not capriciously a

according to will of spirits, demons or ghosts, but according to laws which we may learn & accomodate ourselves to. Not destroy sense of presence of spiritual forces, but merely the idea that they are capricious.

Get them to understand the meaning and purpose of mathematics (and science)

(a) immediate & practical

(b) the study of quantitative relationships in God's world

(c) as symbolism and generality & law

(d) as a tool lint. To save thought

(g) Time, space & matter as unified by mathematics.

Have them understand the interconnections of all the different branches of mathematics and science.

Try to work out in relation to best, most fruitful contact & mingling of two cultures.

Prof Klein's Draft of Science Syllabus for the Modern School, Delhi.

First 3 years fit boy for matric, the 4th year fits him for O.x. & Camb. School certif. Exams.

See typed sheets

I Year.

Physics.

A. Measurement. Measurement of length, area, volume, mass, weight, density by simple methods.

B. Hydrostatics. Properties of matter, fluid pressure, pressure of liquids, principle of Archimedes, floating bodies and hydrometers, atmospheric pressure, water & air pumps, hydraulic press, siphon.

C. Velocity, acceleration, force, parallel forces, centre of gravity, simple machines, Newtons Laws of Motion, units of force, work & energy.

D. Heat. Heat, temperature, thermometers, expansion of solids, liquids & gases, calorimetry, specific heat, change of state, melting or fusion, vaporization, water vapor in the atmosphere, condenation and convection, radiation.

The teacher will direct attention to the following: bow glass pendulum as built by Galileo, grandfather's clock, balance wheel of a watch, spring balance, Practical tables of stable equilibrium, a simple crane, canal boat, garden roller, bicycle crank, flying kite, aeroplane.

In the case of simple machines, he will direct attention to a pair of scissors, nut crackers, common balance, steel yard, force arm, pair of short tongs, riding a bicycle in right and wrong way, platform balance, weigh bridge, windlass, builder

pulley, toothed wheels, Water supply of a town, ice bergs, a balloon, vacuum automatic brake, bicycle pump, flight of a golf ball soap bubbles and films, freezing of a pond, snow balls & glaciers, refrigerating machines, cloud & rain, mist & fog, hail, steam engine.

Chemistry.

Physical & chemical changes, mixtures and compounds, solution, distillation, filtration & decantation, crystallization & precipitation, effects of heat on common substances e.g. burning of sulphur or burning of a candle, action of heat on metals, rusting, oxygen as a constituent of air, preparation of oxygen. The inactive part of air. Nitrogen, water. Action of metals on water. Hard & soft water.

Distillation of water. Analysis of water. Carbon & carbon dioxide; purifying action of plants, preparation of carbon dioxide, its action on lime water.

II. Year.

Physics.

Light. Propagation

Educational Books.

Macdougall's Individual Science series.
Longmans Green (U. of London).

× The Teaching of Practical Arithmetic
by J. L. Martin. Geo. G. Harrap & Co. London 1908

× Practical Plane & Solid Geometry (also graphic arithmetic). Geo. Gill & Sons. 13 Warwick Lane, London, E.C.

× Elements of General Science – Caldwell & Eikenberry
Ginn & Co.

× ✓ Easy Experiments in Science – Hubert Mc Kay
Oxford U. Press.

× Discovery – or the Spirit & Service of Science.
by R. A. Gregory – Macmillan 1919

× Source of Nature's Great Forces." – Mc Dougall – (Putnam)

× ✓ Science Question Papers – Punjab University
Shiv Das & Co., publishers, Machhi Hatta, Lahore

× ✓ Graduated Course of Natural Science"
by B. Searle – Macmillan 1918. (Simple apparatus wholly derived from expt).

All marked × are in Modern School Library at Delhi.

"Tell me Why Stories about Great Discoveries" –
by Clowdy – Harrap.

"Education: Its Data & First Principles"
Prof of Education Univ of London.
by T. Percy Nunn Edward Arnold, London 1925.
Has excellent chapter bibliographies
"The Teaching of Algebra" – ibid.
"What Is & What Might Be – Edmond Holmes
Constable – London

E. K. Broadus – "Books & Ideals" 5/5. net
Oxford Press.

Punjab University Requirements for Matriculation Examinations: 1926 and 1927

Mathematics.

Geometry. 1929 also

"The paper in Geometry shall contain questions on Practical and on Theoretical Geometry. Every candidate shall be expected to answer questions in both branches of the subject.

"The questions on practical Geometry shall be set on the constructions contained in the annexed schedule A., together with easy extensions of them. In cases where the validity of a construction is not obvious, the reasoning by which it is justified may be required.

"The questions on Theoretical Geometry shall consist of theorems contained in the annexed Schedule B, together with questions upon those theorems, easy deductions from them, and arithmetical illustrations. Any proof of a proposition shall be accepted, which

appears to the examiners to form a part of a systematic treatment of the subject: the order in which the theorems are stated in Schedule B is not imposed as the sequence of their treatment.

"In the proof of theorems and deductions from them, the use of hypothetical ~~proofs~~ constructions shall be permitted. Proofs which are only applicable to commensurable magnitudes shall be accepted."

Schedule A.

Bisection of ∠s and of straight lines.
Construction of perpendiculars to straight lines.
Construction of an ∠ = to a given ∠.
Construction of parallels to a given straight line.
Simple cases of the construction from sufficient data of △s and quadrilaterals.
Division of straight lines into a given number of equal parts & into parts in any given proportions.
Construction of a triangle equal in area to a given polygon.
Construction of tangents to a circle and of common tangents to two circles.
Simple cases of the construction of circles from sufficient data.

Construction of a fourth proportional to three given straight lines, and a mean proportional to two given straight lines.

Construction of regular figures of 3, 4, 6, or 8 sides in or about a given circle.

Construction of a square equal in area to a given polygon.

The construction of a circle about or in a given triangle.

Division of a given straight line in extreme and mean ratio.

Construction on a given line of a figure similar to a given rectilinear figure.

To find a point in a given straight line such that the sum of the distances of two given points from it is a minimum.

Two sides of a triangle being given, to construct a triangle such that its area is maximum.

Schedule B.

1929

Angles at a Point.

If a straight line stands on another straight line the sum of the 2 ∠s so formed = to 2 rt ∠s; and the converse.

If 2 st lines intersect, the vertically opposite ∠s are equal.

Parallel Straight Lines.

When a straight line cuts two other

straight lines if
(i) a pair of alternate ∠s are equal, or
(ii) a pair of corresponding ∠s are equal, or
(iii) a pair of interior ∠s on the same side of the cutting line are together = to 2 rt ∠s, then the 2 stt lines are parallel; and the converse.

Straight lines which are parallel to the same straight line are parallel to one another.

Triangles and Rectilinear Figures.

The sum of the ∠s of a Δ = 2 rt ∠s

If the sides of a convex polygon are produced in order, the sum of the ∠s so formed = 4 rt ∠s

If 2 Δs have 2 sides of of the one equal to 2 sides of the other, each to each, and also the ∠s contained by these sides equal, the Δs are congruent.

If 2 Δs have 2 ∠s of the one = 2 ∠s of the other, each to each, and also one side of the one = the corresponding side of the other, the Δs are congruent.

If 2 sides of a Δ are equal, the ∠s opposite these sides are equal; and the converse.

If 2 Δs have the three sides of the one equal to the 3 sides of the other, each to each, the Δs are congruent.

If 2 rt ∠d Δs have their hypothenuses equal, and the one side of one = the one side of the other, the Δs are congruent.

If 2 sides of a Δ are unequal, the greater side has the greater ∠ opposite to it; and the converse.

Of all the straight lines that can be drawn to a given straight line from a given point outside it the perpendicular is the shortest.

The opposite sides and ∠s of a parallelogram are equal, each diagonal bisects the parallelogram,

and the diagonals bisect one another.

If there are 3 or more parallel straight lines, and the intercepts made by them on any straight line that cuts them are equal, then the corresponding intercepts on any other straight line that cuts them are also equal.

Areas.

Parallelograms on the same or equal bases and of the same altitude are equal in area.

Δs on the same or equal bases and of the same altitude are equal in area.

Equal Δs on the same or equal bases are of the same altitude.

Illustrations and applications of the geometrical theorems corresponding to the following algebraical identities:-

$$\text{le}(a+b+c+\dots) = \text{lea} + \text{leb} + \text{lec} + \dots,$$

$$(a+b)^2 = a^2 + 2ab + b^2$$

$$(a-b)^2 = a^2 - 2ab + b^2$$

$$a^2 - b^2 = (a+b)(a-b).$$

The square on the side of a Δ is greater than, equal to, or less than, the sum of the squares on the other 2 sides, according as the $\angle$ contained by these sides is obtuse, rt or acute. The difference in the cases of inequality is twice the rectangle contained by one of the 2 sides and the projection on it of the other.

Loci.

The locus of a point which is equidistant from 2 fixed points is the perpendicular bisector of the straight line joining the 2 fixed points.

The locus of a point which is equidistant

from 2 intersecting straight lines consists of a pair of straight lines which bisect the ∠s between the two given lines.

The Circle.

A straight line, drawn from the centre of a circle to bisect a chord which is not a diameter, is at rt ∠s to the chord: Conversely, the perpendicular to the chord from the centre bisects the chord.

There is one circle, and one only, which passes through 3 given points not in a straight line.

In equal circles (or in the same circle) (i) if 2 arcs subtend equal ∠s at the centres, they are equal; (ii) conversely, if 2 arcs are equal, they subtend equal ∠s at the centres.

In equal circles (or in the same circle) (i) if 2 chords are equal, they cut off equal arcs; (ii) conversely, if 2 arcs are equal, the chords of the arcs are equal.

Equal chords of a circle are equidistant from the centre; and the converse.

The tangent at any point of a circle and the radius through the point are perpendicular to one another.

If 2 ○s touch, the point of contact lies on the straight line through the centres.

The angle which an arc of a ○ subtends at the centre is double that which it subtends at any point on the remaining part of the circumference.

∠s in the same segment of a ○ are equal; and, if the line joining 2 points subtends equal ∠s at 2 other points on the same side of it, the 4 points lie on a circle.

The angle in a semi-circle is a rt ∠; the ∠ in a segment greater than a semicircle is less than a rt ∠; and the angle in a segment less than a semicircle is greater than a rt ∠.

The opposite angles of any quadrilateral inscribed in a ○ are supplementary; and the converse.

If a straight line touches a ○, and from the point of contact a chord be drawn, the angles which this chord makes with the tangent are equal to the angles in the alternate segments.

If 2 chords of a ○ intersect either inside or outside the ○, the rectangle contained by the parts of the one is equal to the rectangle contained by the parts of the other.

Proposition: Similar Triangles.

If a straight line is drawn parallel to one side of a Δ, the other 2 sides are divided proportionally; and the converse.

If 2 Δs are equiangular their corresponding sides are proportional; and the converse.

If 2 Δs have one ∠ of the one equal to one ∠ of the other, and the sides about these equal ∠s proportional, the Δs are similar.

The internal bisector of an angle of a Δ divides the opposite side internally in the

ratio of the sides containing the ∠, and bisecting the external bisector externally.
The ratio of the areas of similar △s is equal to the ratio of the squares on the corresponding sides.

Syll. for 1926

<u>Arithmetic</u>. – Numeration, Notation. The 4 fundamental rules, Factors and Prime numbers, G.C.M. and L.C.M.; Vulgar and Decimal Fractions, including simple forms of recurring decimal; Ratio and Proportion, Simple and Compound Interest; Proportional Parts; Profit and Loss; Discount. Averages; Square Root, Areas of rectangles and circles; Volume of rectangular parallelopipeds and right circular cylinders, Decimal approximations, the calendar, Elementary graphs, practice, simple cases of stocks & shares.

Gl

also for 1929

Algebra. — Simple equations with one or more unknown quantities and problems. Involution and evolution, Factors. HCF & LCM, Fractions, Indices, Surds, Ratio and Proportion, Simple Identities and Elimination, Simple graphs of equations of the 1st degree.

Physics & Chemistry

For 1926 and 1927.

Any one of the following books may be used as a guide for practical work:—
"Practical Physics and Chemistry and Laboratory Note Books", by R.S. Prof. Ruchi Ram Sahni;— "A Manual of Practical Science", by Lala Giridhari Lal, B.Sc.;— Practical Physics and Chemistry, by Ram Bhiya Lal Seth, M.Sc. and Raja Bhan Pa Singh, B.A., B.T.;—

"A Book on Practical Science for M. S. L. C. Candidates", by Sola Mukund Sal Bhatta M. Sc.

Physics. PP 29

"Greater emphasis should be laid on the experimental portions and on the applications of fundamental principles in every-day life. Space, time and matter. Methods of observation. Recording experiment. Measurement. Simple measurements of length, area, volume, mass and density in British and Metric systems. Use of the spring balance and the simple form of the school balance. Three states of matter and their characteristic properties. Bramah Press; Pressure of fluids; Principle of Archimedes. Specific gravity of solids and liquids and their determination by hydrostatic balance; floating bodies,

Hydrometer. Balloon. Atmospheric pressure. Simple barometer, Water pump and syphon.

Simple idea of Velocity, acceleration. Graphic Representation. Elementary notions of inertia, momentum, force. Three laws of motion. Mass and weight. Laws of gravitation. Center of gravity. Equilibrium of two forces, three rules of equilibrium of a body.

Moment of a force., principle of lever; simple pulley.

Source and effects of heat; heat and temperature. Nominal thermometer; Maximum and Minimum Thermometer.

Units of heat, specific heat, thermal capacity, latent heat of water, latent heat of steam. Measurement of

specific heat of a solid, and of latent heat of water by the method of mixture.

Change of state. Fusion. Determination of melting point. Freezing mixture. Evaporation and boiling. Determination of boiling point. Experiments to illustrate change of boiling point with pressure. Vapor in air. Condensation of water vapor. Dew point. Cloud, rain, snow.

Conduction of heat, good and bad conductors; convection; ventilation, convection currents in nature. Radiation of heat. Good radiators, good absorbers and good reflectors of heat rays. Condition for the formation of dew.

Sources of light. Light travels in straight lines. Pinhole images, shadows, eclipses.

Reflexion of light; laws of reflexion of light; image of light by reflection from a plane mirror.

Refraction of light; laws of refraction of light; experimental determination of index of refraction of glass and water by the simple application of the law. Refraction through a prism. Dispersion through a prism. Colour of bodies.

Convex lens; real images by a convex lens; experimental determination of focal length of a convex lens. Convex lens used as a magnifying glass. Principles of photographic camera, magic lantern, astronomical telescopes and microscope.

Electrification of bodies. Positive and negative electricity. Gold leaf electroscope. Conductors and insulators. Charging an electroscope by friction and conduction. Electric induction, charging an

electromagnetism by induction. Electrophorus.

Single voltaic cell. Local action and polarization. Description of Bunsen cell, Daniel cell, Leclanche cell. Two or more cells in series. Production of heat and light by electric current. Oersted's experiment. Principle of galvanometer. Electromagnet. Electric bell. Electrolysis and electroplating.

Properties of magnet, making of a magnet, mariner's compass.

1929 also

Practical physics. An acquaintance with the use of the yard, foot and inch, the metre, centimetre and millimetre in the measurements of simple lengths, areas and volumes; the use of a simple balance with gramme, decigramme, and

To determine the melting point of wax and naphthalene

To determine the boiling point of water

To show the effect of reduced pressure on the boiling point of water

To compare the rate of cooling of dull and brightly polished surfaces

To show that light travels in straight lines.

To prove that the angles of incidence and reflection are equal

To verify the laws of refraction, to trace (MO) the path of rays through a prism.

Bombay, ... 191...

Syllabus in Practical Physics for 1929

The use of the yard, foot & inch, the meter, centimeter and millimeter in the measurements of simple lengths, areas and volumes.

The use of the spring balance and the simple balance

To find the relative density of a liquid by means of a specific gravity bottle

To find the relative density of a solid by Archimedes principle.

To show the action of a siphon

To show that liquids and gases expand

To set up a simple voltaic cell, a Daniel cell and a Leclanche cell.

To determine the direction of an electric current by a magnetic needle.

To set up an electric bell in circuit.

To magnetize steel, using a bar magnet.

To make a simple electro-magnet

centigramme weights; the simplest application of the principle of Archimedes to obtain the density of solids; the reading of a simple barometer (without vernier): the reading of a Centigrade or Fahrenheit thermometer; formation of images by a convex lens; magnetizing a knitting needle; charging an electroscope; charging a Leyden jar; Oersted's experiment. [~~For 1927, Practical Physics, delete "charging a Leyden jar"~~]

1929 etc

Chemistry.

Physical and chemical changes. Elements, compounds and mixtures, metals and non-metals. Chemical combination and decomposition.

Solution, decantation, filtration, evaporation, distillation. Saturated solution.

crystals, crystallization. Sublimation. Composition of air. Oxygen, nitrogen, impurities of air. Deliquescent bodies. Air a mixture.

Chemical affinity, preparation of Oxygen, its properties and uses. Oxidation reduction, combustion. Parts of candle flame.

Hydrogen, its preparation and properties. Water, its properties and composition by electrolysis. Rain, spring, mineral and sea-waters; hard and soft waters. Softening of hard waters.

Organic and inorganic compounds. Allotropic forms of carbon. Coal, charcoal. Burning of a candle. Action of plants on CO_2.

CO_2, its preparation, properties and uses. Limestone. Lime and slaked lime. Forms of calcium carbonate and calcium

sulfate.

HCl, its preparation and properties. Chlorides, Sulfur. Its varieties, effects of heat upon it in a closed vessel and in air. SO_2 and its properties. Sulfuric acid, its properties and action on metals. Sulfates. Phosphorus - red and yellow. Matches.

Nitric acid. Its preparation, properties and uses. Nitrates. Distinction between HCl, H_2SO_4 and HNO_3. Ammonia and its properties.

Ores and metals. Alloys and amalgams. The more important salts of sodium and potassium.

Properties of the following metals: Copper, mercury, silver, zinc, lead, tin, iron, and aluminum.

Practical chemistry. ~~1924~~ 1929

Soluble and insoluble solids. Decantation. Filtration. Distillation.

Solubility of things in acids.* The burning of a candle and the parts of a flame. Preparation of oxygen from oxygen mixture and the study of its physical and chemical properties. Preparation of hydrogen by the action of zinc on dilute sulfuric acid and the study of its physical and chemical properties. Preparation of carbonic acid gas and the study of its properties, physical and chemical. Burning and breathing. Distinction between acids, alkalies and salts. Distinguishing tests of the three important acids.

*[For 1927: Instead of "solubility of things in acids" substitute "Description of the action of strong and weak hydrochloric, nitric and sulfuric acids on common substances" and add "cook

boring and bending of glass tubing".]

Books recommended are:-

"Lessons in Science", - Gregory and Simmons, Indian Edition. (Macmillan)., or "A Class Book of Science". (Vol I Physics, Vol II Chemistry) by S. Prem Singh, M.Sc. and S. Ram Bhaja Mal, M.Sc. (published by Messrs. Uttar Chand Kapur and Sons, Lahore).

Add

Extracts from Punjab Education Code.

General Rules for Schools; Courses of Study

8th Ed. 1914. Volume. Publ. by R.B.L. Mohan Lal at the Mufid-i-'am Press. 10 As.

Scheme of Studies for Anglo-Vernacular Middle and High Schools for boys.

Recommended proportion of time allotted to different studies (p. XXXII)

~~Vernacular (Urdu, Punjabi~~	~~Periods~~	~~Periods (c. 45' each)~~	~~Hours (approx.)~~
Vernacular (Urdu, Punjabi or Hindi)		4	3
English		10	7 1/2
Third Language (Persian, Arabic, Sanskrit and modern)		3	3 3/4
Mathematics (Arith. Algebra & Geom.)		6	4 1/2
History & Geography		5	3 3/4
Science		4	3
Drawing (as compulsory teachers become available)		2	1 1/2
Total		36	27

Physical training, half-period daily, except on half-holidays.
Recess, a period or half a period daily, except on half-holidays.
Science may be made alternative with the third language, if desired.

Syllabuses.

4. Science. - As for Vernacular Middle schools, but the following may be substituted, if desired in the Sixth (First middle) Class:-

Measurements -

(a) Of length (including straight and irregular lines).

(b) Of area (including irregular surfaces)

(c) Of volume (including irregular bodies)

(d) of Mass (weighing).

This part of the work should include the use of the metric measure, a pair of compasses

and the balance. The use of squared paper should also be taught.

Mechanics. —

Physical properties and states of matter; special properties of solids (e.g. malleability, ductility, tenacity, hardness); level of liquids (fountains and springs). Note. —
The practical exercises should be done by the pupils themselves, under the direction and supervision of the teacher.

The Elementary Science Syllabus for Vernacular Schools (referred to above) is thus: —

Sixth Class.

Object lessons in Elementary Science, as follows: —

I. General Notions.

1. Cause and Effect
2. Sense of Nature

~~II. Physics~~ (over)

II. Physics –

1. Heavy and light bodies
2. Mass and bulk
3. Porosity – a piece of blotting paper
4. Level of water. A fountain
5. Solution and suspension of matter in water
6. Filtration
7. Distillation
8. Heat the cause of motion in the air
9. Winds
10. Ventilation
11. Animal heat – Use of clothing
12. A looking glass and how to make it
13. The image in the looking-glass, and its relation to the object.

III. Chemistry. –

1. Elements and compounds
2. Mixtures and chemical compounds
3. General properties of metals
4. Soap, and how to make it
5. Presence of aqueous vapour in the air
6. Coal gas.

IV. Geology –

1. Destructive and constructive action of water
2. Stratification
3. Salt and its sources of supply

V. Botany

1. How a plant grows
2. Parts of a flower and their functions

VI. Physiology

1. The Skin – Perspiration

Seventh (Second Middle) Class.

Mechanics —

Motion, Inertia, and Force, Gravitation, Centre of Gravity, Cohesion (adhesion).

Liquids.

1. Transmission of pressure by liquids. The Bramah Press.
2. Pressure of liquids
3. Principle of Archimedes, density and specific gravity
4. Capillarity

Gases —

Pressure and weight of air; the barometer, the air pump, the water pump, the syphon.

Heat. Effects of heat, thermometers.

Light —

1. Propagation of light (velocity excluded)
2. Reflection of light (plane surface only).

Sound

Production [illegible]

Eighth (Third Middle) Class.

Heat

Change of state, melting point, boiling point, and vapour.

Quantity of heat and its measurement; Specific heat and latent heat, transference of heat.

Light –

Refraction of light, refraction through a prism, lens (convex only) and the image given by it (to be taught experimentally); the following optical instruments: – the simple telescope, the simple microscope, the camera obscura, the magic lantern.

Magnetism.

Magnetic attraction and repulsion, poles of a magnet, methods of magnetisation.

Frictional Electricity.

Two kinds:- ~~Conductors.~~
Conductors, non-conductors and insulators, induction.
Gold leaf electroscope. Plate electrical machine.

Current Electricity.

Grove's and Bunsen's cells.
Effects of an electrical current.
N.B. In science teaching, demonstrations by the teacher before the class are not sufficient; experimental work should be done by the pupils individually.

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5. Arithmetic and Algebra (Anglo Vernacular)
Sixth (First middle) Class.

Decimals: Metric system for lengths
Conversion of vulgar into decimal fractions and vice versa
Addition, subtraction, multiplication and

division of decimals. (Running decimals omitted)

Means. Arithmetical Averages

Inverse cases of simple interest. Percentages

Seventh Class.

Literal Arithmetic, substitutions, use of symbols and equations of the 1st degree. (The equations to involve only integers)

Compound practice

Time and work

Profit and loss (simple questions)

Graphic illustrations for (a+b)

Proportional parts.

Eighth Class.

Squaring by applying (a+b)

Square root

Equations of the 1st degree and problems leading thereto.

- Volumes of rectangular parallelopipeds, solids.

Compound interest without inverse cases.

Notes.

(a) The teaching of Geometry and Arithmetic should be coordinated as far as possible.

(b) Oral work in simple examples should be encouraged throughout.

(c) The reasons for the various rules of Arithmetic must be understood by the pupils, though a formal statement of the proofs should not be demanded from them.

(d) The examples should be as far as possible such as occur in daily life or are required in the teaching of Physical Science.

(e) It is recommended that one period every week should be devoted in every class to the revision of rules already learnt.

(6). Geometry.

Sixth Class.

- Introduction to the ideas of solid, surface, line, point.

Models of the following solids:-
Cube, cuboid, tetrahedron, prism, cone, cylinder, sphere, hemisphere.

- Simple exercises in paper folding.
- Measurement of straight lines correct to within 1/20 of an inch or centimetre.
- Measurement of angles to the nearest degree.

Seventh Class.

1. Simple constructions to be made with scale compasses, protractor and set square.
2. Fundamental theorems of geometry to be discovered and proved by experimental work.

The following scheme is recommended:

I. Draw an $\angle$ = to a given $\angle$ –

If a straight line stands on another straight line, the sum of the 2 $\angle$s so formed = 2 rt. $\angle$s; with the converse theorem.

If 2 straight lines intersect, the vertically opposite $\angle^s$ are equal.

The sum of all the $\angle^s$ formed by straight lines meeting at a point is 4 rt $\angle^s$.

II. Construction of parallel straight lines. Equality of alternate and corresponding angles.

III. Construction of triangles with –

(i) three given sides

(ii) two sides and included angle

(iii) one side and two angles.

<u>Congruence of Triangles.</u>

IV. The sum of the $\angle^s$ of a Δ is = to 2 rt $\angle^s$

If the sides of a polygon are produced in order, the sum of the external angles is 4 rt $\angle^s$.

V. If two sides of a Δ are equal, the angles opposite to these sides are equal; and the converse theorem.

VI. Bisection of a straight line and of

an angle.

Drawing a perpendicular to a given straight line from a point on or without the straight line.

Eighth Class.

VII. Areas of figures:-

1. Rectangle and parallelogram
2. Triangle in terms of a side and a perpendicular
3. Circle
4. Area of figures calculated by squared paper and illustrated by balance

VIII. Ratio and Proportion. Similar triangles. Construction for drawing fourth proportional and mean proportional.

IX. Volumes of Solids:-

(i) Cuboid - parallelopiped

(ii) Cylinder

Books recommended.

1. Godfrey and Siddon's Geometry for Beginners.
2. Chatterji's Experimental Geometry
3. Sola Tej Rai's 'Anali Handa' (Urdu).

Subject — [illegible]

By [illegible]

1. Factors
   (a) H.C.F. & L.C.M. [illegible]
   (b) [illegible]
   (c) [illegible]
   (d) [illegible]
   (e) [illegible]

2. Simple Factors
3. Indices [illegible]
4. Quantity Values
5. [illegible] Simple Interest
6. Percentage
7. Square Measure

They should also be able to [illegible] of [illegible] [illegible] [illegible]

Good Books for Mathematics

Appleton & Co. 4s 6d.

MacMillan & Dewey - "Psychology of Number"

Jeannie B. Thomson - "Art of Teaching Arithmetic"

1923. Longman, Green & Co.

Ibid "An Experiment in Number Teaching"

with diagrams - 2s. 6d.

Beatrice Branford "Study of Mathematical Education"

Oxford Press 4s. 6d. 1921

Ibid - "James & Vesta" (general education)

For development of Notation see

Sarah Cummington - "Story of Arithmetic"

Sonnenschein - about 3s. 6d.

M. E. Boole - "Lectures on Logic of Arithmetic" -

Oxford - 2s.

F. Cajori - "History of Elementary Mathematics" -

Macmillan. About 5s.

Ball's - History of Mathematics Macmillan

Ball's -

Finke's - History of Mathematics" - Open Court Pub Co.

Indian School Supply Depot

309 Bow Bazar St. Calcutta

Indian (urdu) Names of Arithmetical Terms.

unit = ikai

number = adad

arithmetic = hisab

numeration = adadon ka parhna

notation = adadon ka likhna

intrinsic value = asli qimat

— place value = maqamiqimat

concrete number = adad-i-maqrun

abstract number = adad-i-mujarrad

— addition = jama

— subtraction = tafriq

— multiplication = zarb

— division = taqsim

— sum or total = { hasil-i-jama, or maqruna

plus (+) = mushat

is equal to (=) = musawi

minuend = mafruq minuh

subtrahend = mafruq

remainder = baqi

an expression = jumla (e.g.) (6+5a)

terms = rukn

reduction = tahwil

positive number = adad-i-muabat

negative number = adad-i-manfi

multiplicand = magrub

multiplier = magrubafi

product = hasil-i-zarb

power = quwwat

index = quwwat nama

divisor = maqsumalah

dividend = maqsum

quotient = kharij-i-qisamat

remainder = baqi

£, s., d. are the first letters of 3 Roman coins, libra, solidus, denarius.

barter or exchange = tabadla

mixture = amezish

factor or measure = ād

multiple = zef.

even numbers = juft

odd numbers = taq

prime number = adad-i-ula

consecutive integers = muttasila ādād

composite number = adad-i-murakkab (eg. 14, 10, 35)

common factor = ād-i-mushtarak

greatest common measure = H.C.F. or H.C.D. = ad-i-azam

common multiple = zaf-i-mushtarak

least common multiple = zuazaf-i-aqal

fraction = maksur-i-ām

denominator = makhraj

numerator = shumar kasuda

vulgar fractions = kasur-i-ām

decimal fractions = those whose denominators are 10, 100, 1000 etc = kasur-i-āshāria

square root = jazr

ratio = nisbat

per cent. = fi-sadi = for every hundred

debtor = Daraydār

creditor = Darayakhāh

debts or liabilities = Darzā

assets or estate = Jāedād

insolvent or bankrupt person = diwalia

insurance = bima

partnership = sharākat

profit = nafa

loss = nuqsan

cost price = qimat-i-kharid

selling price = qimat-i-farokht

interest = sūd

principal = asl-i-zar

rate per cent per annum = sharah-i-fi-sadifa-sal

yearly = sālana

quarterly = sehmāhī

half-yearly = shashmāhī

discount = nīti kāta

present worth = qimat-i-naqd

specific gravity = wazan-i-makhsus

stock = Rās-ul-māl

share = hissa

The Imperial Stationary Mart
Darika Kalan, Delhi

Purpose of a Textbook

[illegible]

Place value, zero, [illegible]

[illegible]

Tutors. Opinions. [illegible]

Spend time on perhaps 2 units on the above

The will have following advantages: a reason for [illegible] a method of [illegible] a [illegible] a [illegible] a [illegible] a problem [illegible] The above significance of [illegible] adding [illegible] to it, [illegible] their [illegible] a [illegible] [illegible] to my personality, my [illegible], my [illegible]; [illegible] their use of [illegible] knowing, [illegible] of [illegible] of me, and [illegible] [illegible] [illegible] their [illegible] [illegible]

[illegible]

[illegible]

[illegible]

There are 8 [illegible] periods of [illegible] and 4 periods per week for science. There is 32 in [illegible] periods in all. Putting 1 period per week for explanation and discussion of theory; perhaps [illegible] period on the equivalent per week for explanation of experiments. [illegible] approximate alone. This allows 32 periods for theory and 96 for experiment. If [illegible] covered, most time will be given to mechanics and hydrostatics, including gases. Putting little time on [illegible] light.

On first day [illegible] [illegible] [illegible]

Syllabus for Math., - see book used, i.e. "Introductory Course in General Mathematics", by H. E. Howard, Part I. Oxford University Press. 1925. Divided by quarter about 40-50 pp each quarter.

Syllabus for Physics

I. Quarter.

Measurements :- English, metric and Indian units of length, area, volume, time and weight; measurements of areas; use of squared paper; measurement of irregular ~~solids~~ volumes by displacement of water.

Properties and states of matter

Mechanics: Inertia, motion; momentum, force; velocity; acceleration.

II. Quarter

Mechanics: Center of gravity; gravitation; principle of the lever.

Liquids :- Principle of Archimedes; density and specific gravity; pressure of liquids; transmission

of pressure by liquids; the Brahma press; capillarity.

III. Quarter.

Gases: Pressure and weight of air; the barometer; the air pump; water pump; the syphon

Heat:- Effects of heat; thermometers; conduction.

Light:- Propagation of light (velocity excluded); reflection (from plane surface only); refraction.

Books: By class "Individual Work in Science" by Herbert Mc Kay. University of London Press. 1925.

By teacher: "a Class Book of Science" by Prem Singh + N B Seth, Part I.

"Lessons in Science" by Gregory + Simmons (Indian Edition, Macmillan)

Prem Chand

Pooran Sook

Sachu

Fazal

Sohan Lal

Rachel

Grace

Mary

Math. 1st Quarter work 49 pp containing 23 experiences & 17 pp of text. At 5 days per week, this and 4 weeks per month, we must now (April 27) go at a little over one page per day to finish at the end of the quarter; allowing for set-backs, holidays & oral syllabus on Saturdays. In terms of experiences we must do a little over one experience every 2 days, i.e. half ~~the~~ of one experience per day: The experiences average 12-16 problems each. ∴ I try to do 8 problems per day. This will be impossible at first. Probably make selection & do not attempt to do all the problems in each experience. Can't average more than 4 at the start, perhaps less; especially of those involving measurements and use of instruments. Will have to take

at least 2 days to get the idea of angles into their minds in a fundamental way.

Re Physics, there are about 20 pp to cover in mechanics for 1st quarter. Try giving 2 talks per week, each of 30 to 40 minutes. Tues & Wed would perhaps be best. On Saturday use 10 minutes for a synthesis of weeks work. Emphasize its connections inter se & with village life & other subjects. Speak of similarities & unities rather than of the diversities, details & analyses.

Saturday Syntheses & Review

~~Theses~~

Summarize the work of the week and relate it to itself and to work of previous weeks. Also relate it to work in other school courses, beginning with inter-relations of math and science, but also relating to geography, history, Urdu, English. Speak perhaps of forthcoming work of the next week or of the remainder of the quarter or of the year. Relate it to daily home & village life & hill life in general, both in examples and purposes.

In the review speak of similarities and unities rather than of the divisions, details and analyses. Set this be unconscious at first. Later show them the two processes & let them be aware of my purpose.

Relate it somehow to cultural unity

and make it fruitful conscious contact of E + W culture, not disruptive. Relate consciously or otherwise to spiritual matters, so as to avoid scepticism.

Qualities to develop on them are accuracy of observation, thought & work, truth, courage to face truth, imagination, logic; healthy scepticism, i.e. absence of dogmatism; freedom and openness of mind, curiosity, enthusiasm, caution, realization of unity of head knowledge and hand knowledge, respect for hand knowledge and work, honesty of work and thought, ability to reason; ~~accuracy of~~ sense of unity of knowledge; respect & devotion to Hill culture & to India; sense of unity of life & of the world; of the fundamental importance of ~~[illegible]~~ group of

sense of reality & fact, & ability to reason

space & time; idea of causation; idea of limitations of science; scientific & mathematical knowledge as ways of looking at the world and as instruments of knowledge & of life (usefulness), knowledge of sources of error, degree of error, usefulness, courage in face of forces of nature (control of superstition & evil spirits), approximation

Suggestions for topics of Reviews ~~in Physics~~.

Phys May 1. States of matter, motion, velocity. Unity of world as matter. Subject to laws or ways of acting. Correlate with home life, geography, history, weather. Measurements – to learn laws. Checking results, accuracy. Correlate with arithmetic + geometry.

Phys May 8. Unity of world as matter. Velocity. Measurements. Step by step. Sat. accuracy, checking results. Do the field of matters.

First Quarterly Exam in Math. June 28 1926.

1. Draw a straight line 3.7 cm long. Add to it in the drawing another straight line 2.4 cm. long. How long then is the whole line, in cm. and dm, by measurement and by calculation.

2. Using your protractor and set square, draw a triangle with one angle a right angle and another of the angles 35°.

3. Draw the two following figures:-
   (a) an equilateral triangle with one side 1.3 in. long.
   (b) a square whose perimeter is 8 cm.

4. Draw a circle with a radius of 2.54 cm. Draw in it a chord ½" long. Draw another circle with a radius of 1.2". What is the average of the diameters of the two circles in inches?

"Elementary Physiology" - Mrs. Ché - Blackie & Son

"Life, Light & Cleanliness - A primer of Hygiene for India" (rev. ed.). 12As. Pub. Rai Sahib M Gulab Singh & Sons. Lahore 1910.

"Hygiene for Indian Schools" - Sir Ronald Ross. Pub. K & J. Cooper Bombay

"A School Book Chemistry for India" - Wilson & Headley Off Univ. Press. 1920. Very good lab suggestions

"Readable School Chemistry" - Cochrane - G Bell & Sons Very good for suppl reading

"A New Sequence Geometry for Schools" - John Gray & F. J. Smith 1924. The Joint Educational Co. Ltd. - London & Glasgow. Has result of 4 recent reports on teaching of Math. Suggestive for teachers.

"Common Sense Algebra for Juniors" by F. F. Potter & J. W. Rogers. Isaac Pitman & Sons. 1924. Very good. Excellent

diagrams & interesting practical problems. Very good on "directed numbers", as introduction to & in explanation of negative quantities & their handling. Treats reversible processes in same exercise. N.E. After expanding a product the pupil next has to factorise it. etc. Cf. Book. Very good on graphs, too.

From same publisher there are same author's (Potter) "Common Sense Arithmetic in 8 parts (paper covers) from 6d to 1s 6d per part. Teachers books from 2s 6d to 5s. net. Also Potter's Teaching of Arithmetic. 7s 6d. Isaac Pitman

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"Drawing & Measuring Instruments" by J.F. Heather. Crosby Lockwood & Son London. Very good. Excellent chapter on slide rule. about 3s.

The following books are recommended by Potter in his "Teaching of Arithmetic": --

"The Cambridge Elementary Arithmetics" by J.H. Webster (Cambr. Univ. Press) as a class book

Text books "An Arithmetic for Preparatory Schools" by Trevor Dennis. G. Bell & Sons, 4s 6d.

"A Modern Arithmetic with Graphic and Practical Exercises" by H.S. Jones, M.A. Macmillan.

"The Windsor Arithmetic" by Godfrey & Bell (Cambr. Univ. Press).

"Arithmetic" by G.W. Palmer - Macmillan

Algebra "Exercises in Algebra" - T.P. Nunn. Longmans and his "Teaching of Algebra"

"Elementary Algebra" - Godfrey & Siddons - Cambridge Univ Press.

"Elementary Algebra" - Carson & Smith (Ginn & Co.)

~~Geometry~~ "Elementary Geometry" - Godfrey & Siddons (Cambr. Univ Press)

"Plane Geometry" - Carson & Smith (Ginn & Co)

Get 1901 British Association "Report of a Discussion on the Teaching of Mathematics". Also Prof Perry "Six Lectures to Working Men on Practical Mathematics" (publ. Wyman)

Also the following Board of Education publications - Circular 807 "Suggestions for the Teaching of Arithmetic"; Circular 884, "The Place and Use of Graphs in Mathematical Teaching"; Circular 85, "Geometry"; Special Reports on Educational Subjects" (ii) "The Teaching of Arithmetic in London Elementary Schools", (iii) "The Teaching of Arithmetic in English Elementary Schools". All these from Wyman & Son, Ltd. Fetter Lane, London E.C.

Practical Mathematics

"An Introduction to Practical Mathematics" by F. M. Sapeley (Longmans)

"A Course in Practical Mathematics" by F. M. Sapeley - Longmans

"A First Book of Practical Mathematics" - Ashmwood & Trimble (Macmillan.

"Practical Mathematics for Technical Students" - Aird.

Teaching. "The Teaching of Primary Arithmetic" by H. Suzzallo - Riverside Press, N.Y.

"The Teaching of Elementary Mathematics" - D.E. Smith. Macmillan

"The Teaching of Mathematics in the Elementary & Secondary Schools" by J.W.A. Young - Longmans.

I, R.B.G., have found the following good text books for elem algebra – Hall & Knight's Elem Algebra – Macmillan, R.W.M. Gibbs Exercises in Algebra, Oxford Univ Press; Potter & Rogers – Common Sense Algebra for Juniors – Pitman

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Best elementary Science on assignment plan is combination of R.H. & Mabel Whitehorne "Assignments in Practical Elementary Science" – Macmillan (Bombay) 1927 and Gregory & Hodges "Experimental Science for Indian Schools", Macmillan 1927

~~Fair~~ good. Elementary Algebra Parts I & II. by P. Ross. Longmans 1924

M. E. Boole - Logic of Arithmetic - Oxford Pres has excellent ideas on 0, ∞, operations with minus quantities, fractions, equivalent fractions, division, multiplication.

Suggestions for course in Physics for Village children, especially Hill children

Z

Begin with familiar things & forces and manifestations and uses of forces. Do not give complete or accurate definition at first. By questions, get them to make rough definitions, to be progressively refined as their experiments and thinking proceeds. Try to begin with instances ~~not~~ which are not only familiar to them (e.g. of forces which they see their parents use) but with actions which they themselves do, so that they can observe more carefully, test with their own senses, experiment with themselves, and which are made interesting so as to stimulate thought and experiment. Stimulate even invention and improvement.

With their way of doing things make comparisons from the ways of other nations, bringing out reasons for differences - environmental, etc. e.g. Plains people use wheel more in carrying (planes, wheelbarrow, etc) than hill people).

Begin with mechanics. Perhaps first force to consider would be gravity. They will already have discussed it in 6th class geography. They all have to carry things - wood, water, books to school, grain, stones, manure, straw, jungle rail. They see things carried constantly. Then, with their own senses (eye, touch, kinesthetic, balance) they know this force. They see bullocks or mules carrying things on road.

By questions work out a definition for weight. Differences in weight.

Properties of different kind of matter in respect to weight. Begin with weights as first kind of measurements. Crude balance first. They have seen it used in bazar & run at home. Begin with Indian & local weights. Then British; then metric. Thus progressively more & more accurate. First weigh stones, then wood, then grains. Use cloth bags. Arithmetical examples. Transformation from one system to another. Drawing a measurement pity ~~than~~ line.

Dont go ahead of a geometry. ∴ Postpone relation of wt to volume till later.

As they are not so familiar with liquids, postpone density & sp. gravity.

Next take center of gravity. Use idea of load high or low on back, losing ones balance, mules falling under poorly loaded burdens. Carrying burdens on back or on head.

Then statics, Balanced forces (gravity only at first). Bridges, towers

construction, cut of roofs, graphic representation.

Principle of Levers (This may have to precede statics). Illustrations, axe, mattock, claw hammer, w nails, arm, leg, body, weighing balance, plow, scissors, foot, tailor-tailor, arms of a ichikaw, horns, a cow or goat, wing of birds. Will sawyer in plains village: insects, grasshoppers legs, Pulling down a tree with ropes. climbers, wheelbarrow, oar, knife, chickens, bellows, umbrella ~~spokes~~ ribs,

Wheels. Potter wheel, gharry, ichikha, water wheel for flour mill in hill, hand flour mill, tabli, charkha, ~~bullock~~ Persian wheel, carpenter's drill, carpenter's turning lathe,

~~Water~~ Liquid. Sailing vessel, rivers, irrigating ditches, canals. Also

By way of experiments in weight, have them weigh roughly equivalent volumes of soil, a stone, sand, wood, wood chips, jungle water, grain, nail, Then have them estimate how much a kutta of each would weigh, or a gharra full.

Then have them state which they would prefer to carry. Then have them compare work expended in terms of foot pounds by comparing carrying different loads to different heights or different distances. Then compare man loads and mule loads. Before they do the weighing, discuss the matter with

3 in centre of gravity, contrast the ease of carrying on back, on head, on shoulders (a la Scouts), on wheelbarrows, on 2 wheels (rickshaws) on 4 wheels

Contrast different ways of carrying etc - on head, on shoulders, on back, 2 or 4 men on shoulders, lifting, style, carts, wheelbarrows

The derivatives, contrast jungle trail, grain straw, grain, sand, soil, stone (lots many little), wood, (oak & pine), ~~[illegible]~~, water.

After principle of lever is clear, ~~give illustr.~~ show pictures of Western devices, - slings, derricks, bridges, machines, cranes. This gives variety in application of principles, - suggestiveness & flexibility in face of unexpected difficulties or new situations. Education in principles ought to give the boys this resourcefulness. Since most of them will not go

to college, the giving of resourcefulness than the understanding of principles, should be one of the chief values of their study of science. Also this will enable them to select what fits with their materials, their tools, their surroundings. To understand a principle thoroughly, each one should both make various applications of it and also see or hear about many other applications of it by other people.

See back of dictionary for examples of mechanisms.

Certain aspects of each subject will be specially useful: E.g. In mechanics, the lever, pulley, wedge, inclined plane, wheel (rollers), Statics, stress, strain, balanced forces, parallelogram of forces.

Heat, cooling, brazing, soldering, welding, expansion & contraction, convection & conduction (winds, heat of roofs), evaporation of water thru plant leaves,

Re Liquids the familiar manipulations or aspects deal with weight, a little with pressure, flow (using low levels). Instance of pressure, a leak in a water vessel. Irrigation ditches for bogs, water in a bucket, water wheel, river. Capillarity is shown by wick of lamp, by water in soil, by ink in blotting paper. Specific gravity is illustrated by wood & buffalo skins floating on water & stones etc sinking to bottom. From this can go on to principle of Archimedes. But omit Bramah press & transmission of pressure by liquids for the present, tho perhaps not.

Take heat before gases so as to prepare the way for effect of heat on air (winds). Effect of heat on solids, liquids & gases. Cooling, blacksmith, burning wood, jewellers, warming room, melting ice or snow, melting wax, growth of plants, rain, winds, melting glue. Measurement by

Assignments on Dalton Plan

From Mar 15 to Dec 20 there are 40 weeks. Deduct 1 week for July harvest holiday, another for Sept holiday and 2 more for scattered holidays, i.e. last Sat of each month, 3 or 4 days in Nov, ~~etc~~ the Thanksgiving week in July, etc. = in all 4 weeks. That leaves 36 weeks for solid work.

Allowing ~~Saturday~~ entirely ~~only~~ for review and oral work in Math and no Sat work in Science, owing to Club meeting ~~that~~ day, gives 5 periods per week in each subject. These periods in Math are 65 minutes each and in Science 44 minutes. Allowing for settling down & delays in starting 5 minutes, this gives 60 minutes for Math and 40 for Sci. per day. This is the unit of time for work

5 x 36 = 180 periods in all to the year

From Aug 22, 1926 to Dec 19, there are 17 weeks

In Math experience shows an average of 3 to 4 problems per ~~hr~~ 3/4 hr. is the usual average speed. For 1 hr. call it 4 problems.

The unit will have to vary according to the difficulty of work. Construction drawing problems take more time than purely arithmetical ones.

Don't prepare more than 2 assignments (each of 4 weeks work) at a time ahead, because you want to correct & change on basis of actual experience with class & accomplishment by pupils, and adapt it to ~~schedule~~ syllabus requirements of university.

Set quick ones go right ahead, within limits of my preparation of assignments. ~~Occasionally~~ Then at end, if they finish well ahead, give them more interesting work in subjects where they are learnt. Or even let them go on to "next year" work, using their difficulties as corrections for assignment & contrast test for the others.

At end he can either be given more advanced work (trig or managing) or specialize in those subjects where he has shown most interest & power. Or he may use it for reading on history of math etc. Or might review all subjects in another book, using a different approach.

But occasionally individual assignments may be enlarged, either by inserting more problems of equal or less difficulty as drill for very dull pupil, or of more problems of greater difficulty on that topic for the bright pupil.

~~The~~ Contract = 1 yr's work

Assignment = 4 wks' (1 month) work

Period = 1 weeks' "

Unit = 1 day's "

~~Number~~ Have ~~the~~ ~~bills~~ ~~Assignment~~ each group of work numbered. ~~Eg.~~ Units had little

be marked conveniently than the year, the other 2 groups also.

Dalton Plan in Math.

Began with 7th class on Aug 22, 1926 at p. 30 of the text book. At that time the class was far behind the schedule I had set for finishing the book that year. In fact at the end of June, when I had hoped they would be at p 48, or 1/3 through the book, they were only at p 24. P was thus held back by slowness of the others. Sampling difficulty has delayed matters matter less getting mutually adjusted. But Mercy is far below 7th Class standard. Rachel is also below. They have at this date, however, been tested by Miss Nam who finds them up to the & indeed ahead of the standard of ability

of 7th classes in Plains. But they were then a little weak in decimal fractions. I.e. remained that subject. They were also weak in compound practice, but that was natural, as they never had it.

They have been given a more thorough revision of principles of arithmetic (together with history) than most classes in India of this standard. I feel ∴ they their foundation (except theory of Radical) is now good in ~~the~~ add, subtr, mult. & div., vulgar fractions, decimal fractions, simple practice, %, ~~interest~~.

This new book was not begun till April 27th. Before that was revision work, using various books.

A Dalton Plan Arithmetic Syllabus.

for Standards 5–7 incl. from Sypnis book.

p. 160.

1. Long rules and short methods
2. Vulgar fractions (the four rules)
3. Decimal fractions (" " ")
4. Metric system
5. Ratio and proportion
6. Mensuration,
7. (a) Long, square and cubic measure
   (b) Areas (rectangle, triangle, circle, irregular shapes)
   (c) Volumes (rectangular solids, cylinders)
7. Compound multiplication (by practice) and division
8. Bills and invoice (shop discount)
9. Household accounts: wages, rent, rates and taxes, insurances (fire, life, health and employment) clubs, hire-purchase.
10. Percentages.

11. Decimalization of money
12. Banking, savings, investments, simple interest, compound interest (Post Office Savings Bank).
13. Averages, profit and loss, proportional parts.
14. Tots
15. Approximations
16. The right-angled triangle.
17. Graphs.

"Note: The whole of the above appear in an easy form in the first two contracts; in an extended and slightly more difficult form, they appear also in the second two contracts. The aim is to provide 'an irreducible minimum' which all boys of ten and upwards might be expected to know in a simple form, and, further, to delete a great deal

that is useless except to boys who have a gift for mathematics. The following have been omitted: large numbers, L.C.M. and G.C.M. (except in a most elementary form), compound and complex fractions, recurring decimals, mensuration of cone, pyramid and sphere, compound interest (the only example claimed is that of the Post Office Savings Bank), stocks and shares, brokerage, discount, square and cube root (except by inspection), rules for contracted methods in decimals, involved problems. Any of these can be dealt with in more advanced assignments when boys have completed the work of the syllabus."

Annotation from Dr. Percy Nunn, on p. ~~197~~ 201 of Sequel's book.

"~~There is little or nothing to~~

"If you will inquire candidly what

amount of arithmetical skill the average citizen needs to carry him respectably through life, you will be surprised to find how small it is. To cast accounts, to check change, to compute prices, occasionally to multiply and divide, every now and then to estimate a percentage — does not this list include practically all the necessary accomplishments? — A child will gain far more from a study of useful and interesting applications of arithmetic than by becoming a virtuoso in the abstract manipulation of figures that mean little or nothing."

Over p. 196-7.

"The Department of Research in the Boston Schools has analyzed all types of addition of fractions from the standpoint of difficulties. The National Society

for the study of Education has found that with very few exceptions, trade and industry and the ordinary operations of life require no denominators higher than 12 in the original addenda."

Syllabus of Natural Science

Syndics Book on Dalton Plan pp 165-167

Contract III (Third year).

Temperature and Pressure.

Assignment:

1. The thermometer (2)

Its fixed points. The barometer

2. Effects of heat. The calorie. Latent heat. How heat travels.

Gases.

3. Air: physical properties. Constituents. Air pressure. Oxygen: the active part.

4. Vapour pressure. Production of hydrogen. Production of carbonic acid gas. Products of combustion

5. The candle flame. Coal gas. Diffusion of gases. Relative densities of gases

Water.

6. Water: physical properties. Its three states. Distillation. Solution.

7. Expansion by heat. Capillarity. Skin tension. Pressure of water.

8. Boiling. Electrolysis. Synthesis. Standard of gravity

Food

9. Respiration. Why we eat. Starch. Sugar.

10. Fats. Proteids. Mineral salts. ~~Vitamins~~ Our mixed diet.

Contract IV. (Fourth Year)

Physics.

Assignment:

1. Levers. Moments. Weighing

~~Moments~~ machines. Parallel forces

2. Parallelogram of forces. Triangle of forces. Gravity & inertia. Centre of gravity.

3. Friction measured. Pulleys. The inclined plane. The pendulum.

~~4.~~ Magnetism

4. Properties of a magnet. Lines of force. Earth magnetism. The dip needle

Electricity

5. A simple cell. A wire conveying a current. Electro-magnetism. An electric bell.

Hydrostatics

6. Density of liquids. Use of Hare's apparatus. Principle of Archimedes

a gauge and a syphon.

7. Pumps. Liquid pressure. The hydraulic press. "Hot water pipes".

<u>Chemistry.</u>

8. Simple chemical reactions. Chlorine Sulphur. Phosphorus.

9. Hydrochloric acid and chlorides, Nitric acid and nitrates. Sulphuric acid and sulphates. Carbonic acid and carbonates

10. Potassium and caustic potash. Sodium and caustic soda Ammonia gas and solution. Lime and the hydroxide.

I Standard - Counting to 100 and multiplication table up to 16X10. Both mental, ~~written~~.

II St. Tables to 16X16. Also + - X ÷ under one up to ~~1000,000,000~~. 10,000 Mental & written mostly written

III. Reading N A & P to pence & reverse Compound addition -, X & ÷ in money & further practice in tables & division tables. (Fraction tables.) More time in mental with than in written. All in order.

IV. Tables of Indian cut & linear measurement & of area & time, paper. Working + - X & ÷ with cuts. & money. & Units of doz. & paper measurements, time, Area of sq. & rectangle & land measurement triangle, circles (Fraction table) Simple interest by Indian method. Sources etc in cooperative bank, buying & selling.

V. G C M & S C M + - X ÷ of fractions. Changing cuts & money

linear measures, small area into fractions.
Decimal fractions + − × & ÷.
Conversion of vulgar fractions into decimal fractions & vice versa.

VI. ~~Da~~ Simple practise; unitary method, vulgar fractions, LCM & GCM of fractions, percentage, average, simple interest, inverse cases of simple interest, areas of rectangular figures. Urdu ed. of Charavarti.

"In Arithmetic, where it is especially important, hardly any opportunity is afforded for practise in swinging the mind between the conceptions of Unity, Negation and Fraction".
M. E. Boole. "Logic of Arithmetic" p 14.

"Education: Its Data & First Principles" - by T. Percy Nunn. p 214

"Of school studies, literature is from the present standpoint the most important; for books which lay their sure foundation in the heart of man' have more power than anything, except the contagion of a noble character, to heighten the sense of life and of its values".

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Try to work out in connection with Science, some training in Probability, Chance, Criticism, Estimation and weighing of evidence, Approximation, Degree of Error, cultivation of Common sense, a logic of guesses.

See in this connection articles in Encycl of Ethics & Relig, also in Cycl Brit on Probability, Logic, Chance, expectation, Evolution, Boole, Poincaré, Charles S Peirce, life summary. ~~Also~~ Common Sense.

See also the book on training of common sense (Hamlin 7/6 net Kegan Paul) Common Sense & its Cultivation by Dr. H.

Approximation, sequence, Causation, ~~statistics~~, Choice, sampling, (life) expectancy, judgment, inference, belief, method

Book on Hindu mind training by an Anglo-Saxon Mother Hindu Blind Training

Sanguine green. Doubt, scepticism,

Of value of detective stories as training in probability.

ETON COLLEGE,

WINDSOR.

Dear Mr Gregg,

I hear from Deighton, Bell & Co. that Whitworth's "Choice and Chance" is out of print and not likely to be reprinted. This is very bad news. I think your best plan now is to fall back on the Chapter in Hall and Knight.

I have been having another look at Woodward's "Probability and Theory of Errors". It is quite useless as a book for beginners, though it may be of value to any of your boys who are capable of reaching more advanced work.

I am sending you my own copy of Whitworth's "Choice and Chance", which I hope you will send back in a few months. I am sending also a Mathematical Gazette (No. 171, July 1924) with a thing of my own in it, which will be quite useless for teaching purposes but may serve to dig a few ideas out of. If it is of permanent interest to you, please keep it; but if not, when the time comes to put it into the waste-paper-basket, please use me as the waste-paper-basket for it, because I want it as ammunition against the superiority of my children when they grow up and begin to think the old man a complete dud.

Yours sincerely,

W. Hope-Jones

1929/28

ETON COLLEGE,

WINDSOR.

Dear Mr Gregg,

I am completely unofficial; but as I am known to be interested in Probability the Secretary of the Mathematical Association and the Secretary of the Boys' Schools Committee have sent on to me your letter of August 23rd about books on the subject.

I am very glad to hear that you are going to teach it, because I believe very firmly in it as a cure for what you call "a lack of critical ability, a credulity and failure to distinguish the probable from the improbable".

I know of no ~~complete~~ satisfactory modern book on Probability. The best I have come across is an ancient one, R.A.Whitworth's "CHOICE AND CHANCE", published by Deighton, Bell & Co., Cambridge, 1886. Bits of this are stodgy, after the fashion of 40 years ago; but the majority of it is readable, it begins at the beginning, and a wise selection from it would make a good elementary course. The second best book I know, though far from satisfactory, is R.B.Woodward's "PROBABILITY AND THEORY OF ERRORS", John Wiley & Sons, New York, (represented in London by Chapman and Hall); cost, one dollar. The worst, which might easily be mistaken for a very good one from its prospectus and table of contents, is Marion Hopkins's "CHANCE AND ERROR, THE THEORY OF EVOLUTION". Kegan Paul, London, 1923.

Hall and Knight's "HIGHER ALGEBRA" Macmillan, London, 1887, contains a chapter on Probability which is not at all bad to start on. I think it costs 6/-. Durell and Wright's "ELEMENTARY ALGEBRA", G.Bell & Sons, London, 1921, gives a dash of Probability, which is good as far as it goes, but too thin to make it worth while to get the book for that alone. 4/6.

I don't know the price of "CHOICE AND CHANCE"; but I am writing to the publishers to ask them to send you a notice of it, or a specimen copy if they will.

I shall be interested to hear what success you have.

Yours sincerely,

W. Hope-Jones

Work out as suggested by Hinton the direct dealing with arrangements of units, so as to learn space, time & cardination (units). Exercises with wooden blocks so as to learn sequence, sequences by running series, within forms, areas, volumes. relation of volumes to surfaces. Connect with abacus & counting devices of lower grades.

For sake of ~~[illegible]~~ interest do measurements of changes – i.e. of daily temperature, of sun's progress by sundial, increase of our height & wt during the year. growth of crystals of salt & sugar increase of ht & wt of plants. Charts. Use time with watch. Note ~~[illegible]~~ frequency of certain occurrences or phenomena. Various simple ways of recording. gallon.

~~[illegible]~~ Have practice in classification & gradation of various ~~[illegible]~~ Do it. sense by sense (1) blindfold touch, (2) smell of things in bottles, (3) digest, sight, as to wt, size, shape, color, smell, smoothness, roughness, friction. Sound, intensity of light, color, shades of color, taste, stickiness, viscosity. Practice in direct use of senses, also of memory of sense perceptions.

Put this work back to 6th class?

numbers of plants or trees per unit of area, of threads per inch of cloth. of wt per unit of vol. Begin with units they know, fineness of grain of wood, stars, stones, soil, wood, clouds

Classify birds, animals, insects, plants, c/c to color, size, shape, length, number of leg, structure, function, food habits, texture, various natural phenomena place of living, coming & going, amount of rainfall per hr. speed per minute, wt a per hr. butterflies.

This all will give practice in measurement, analogies, observation, discrimination, classification, grading, order, sequence in time & in space, generalization, relationships, reasoning, cause & effect, probability. Later begin with ideas of error, control of conditions,

Get them used to different units and scales of measurement of space, time, color, sound, gradation, length, area, volume. Also

Must first train the senses and discrimination — the instruments of observation before we do much with reasoning & understanding of laws or learning of facts. Of analogies Glove on Indian Education.

Classifying of grains, grain plants in field, ears of grain, apple trees, apples, cows, bullocks; of kinds of food c/c to qualities & uses; of people c/c to looks & characteristics.

Get them used to & learn to make quickly & accurately. Have them make for themselves various instruments of measurement, of gradation, of length, ways of reading, — scales, protractors, clocks, sun, sand & water clocks, thermometer, weight, density, volume, Be simple at first

Also microscope.

more accurate gradually. Teach difference between post hoc & propter hoc.

Could the ~~author~~ Nuttall book be translated into Urdu, with my additions, profitably used in 6th class?

Teach them how their senses, & body are used in measurements - "foot" decimal system (ten fingers), cubit, ell, pace, span, hands (hand), finger (width) & digit, pinch of salt, handfull, ... of cabbat, take of it, ~~[illegible]~~ of eg. Then show how these are not always same - inaccurate. Standards.

Practise in arrangement of records, reading, ~~[illegible]~~ lettering & writing. Titles & headings, margins, paragraphs, spacing, arrangement of data, tables, of work, of rough work,

Have temperature noted early morning & noon all thru year, each pupil taking 1 week at it.

Use the book on Hindu mind training in 6th class.

Have them practise with pencils, crayon or paint in making different grades or intensities of shade or color.

Have them gather & bring in leaves of different shades & gradations of green, & of brown & yellow.

~~Understanding of units of measurement - standard units, & different scales (e.g. Brit & Metric)~~

Have practice in judging & making of figures, angles, parallels in field, cattle, pulses. Make - many of these useful & compared with shape of leaf & made. Have & keep - in possible - 10 minutes 4 problems in fractions & use of pattern (measure).

all the preliminary work in observation, discrimination & classification is the way to stimulate accuracy, exactness, ~~sense of reasoning~~ logic, sense of cause & effect, of space & time as such & of relationships therein.

Arrange for rhythmic alternation within the week as between analysis & synthesis.

Have one window in science room a low one & fairly large; so as to get sunshine for plants, for heat effects of sunshine, for ~~[illegible]~~ measurement of sun's movement.

Have them come to see by practice the relative accuracy of their senses, become aware of senses as instruments of knowledge, become aware of inaccuracies & of errors & sources of error, to this helps to humility, to sense of relativity, to accuracy in reasoning & deduction, to proper balancing & estimation of probability. Have them observe differences in accuracy of observation between different people & their causes.

(1) In working out outline first give exercises in analysis (pulling to pieces) then in synthesis (construction, creation) of same thing. Do 3 or 4 of these pairs in succession on

[illegible] & [illegible] [illegible] phenomena, measurable, bringing something to a [illegible] [illegible]. :: To [illegible] where differences or changes can be registered in terms of right & left touch (line, pan, wd).

somewhat similar aspects of same or similar objects, e.g. color, shape, size, wt. (1) differences (2) similarities. (classification) Also pairs of experiences on noting

Have experiences in arrangements & patterns, recurring series & sequences as synthesis of experience in discrimination & seeing of differences.

Such experiences will give at one time practice in discrimination, ~~classification~~ accuracy of observation, sense of relationship or order, classification, sense & increasing mastery of space & time, manipulation, connection between ~~action~~ sense perception and thought, connection between action & symbol, ability to face new situations?, analysis & synthesis. (situations are always more complex than these problems)

(2) Then try to develop ideas of cause & effect. Develop concept of any arrangement or situation as the result of action of forces. Show difference between mere sequence in time & sequence of force + ~~result~~ resulting arrangement. Cite & give practice in mere time sequences (e.g. musical rhythm, & disconnected events).

Then in space sequences. Then show the forces coming those sequences & the resulting arrangements (e.g. the person, gravitation, light, heat, sound, ~~the~~ lightning, political force, desire for money, for power, for ease, for art etc).

For practice use time, space (size, shape), weight, color, sound (pitch, intensity, timbre), ~~sense~~ Cite behind as users of touch sense, intensities of light

Practise with different senses. Use paper folding for manipulation, for syntheses & for analysis.

As suggested by ~~Tom~~ in his book on music, ~~B~~ begin with some demonstrations to excite wonder, interest & curiosity. Have these cover heat, light, sound, inertia, center of gravity, magnetism, electricity, space developments (e.g. unusual Japanese folded paper toys)

Then begin with practice in (analytic-synthetic) arrangements in space & in time. Then arrangements appealing to each sense, sight, sound, touch, smell, taste, balance, kinesthetic, temperature.

Then practice in movements of pole not practise in made beings & appealing altogether as in single spheres, inter-

Literary Digest 7/26/26

SHALL WE TEACH FACTS OR SCIENCE?

IS SCIENCE SIMPLY AN ASSEMBLAGE of unrelated facts? Some school science teachers appear to think so, says Lowell C. Frost, of the high school in Hollywood, California, in *The General Science Quarterly*. But science as a method of thinking is surely more valuable, he goes on. The teaching of factual information is the easy road to a salary for the weak teacher. It is dangerously simple to assign four pages, and check off the ability of each pupil to remember the information in them. But too great stress upon remembering facts is almost certain to leave them unrelated to each other and to thought processes. And it is common experience, Mr. Frost reminds us, that an unrelated fact is usually a fact lost to memory. He proceeds:

"Any fact faces the past. Only when they have joined hands at the behest of an idea, can facts face the future with significance. Single facts are static; joined by a logical thought they are dynamic. Facts are essentially raw materials, and it requires the catalytic action of thought before they can be combined into a useful product. That photosynthesis is the process of manufacturing carbohydrates in a green leaf, is an interesting fact; but it is unproductive until logically linked with the further facts that carbohydrates are the sole fundamental sources of protein, and that protein is essential to the life of every living thing.

"Moreover, is it worth while to burden many minds with many facts, while we have so many good reference books at hand? I know a teacher of geometry who can never remember the value of *pi* beyond the fourth decimal, and who keeps the required figures, along with other facts, in a pocket note-book. He seems, however, to make geometry a joyous and vital thing to his pupils. His mind is full of living thoughts, his note-book of formulæ.

"It would seem, then, that the true function of a teacher of science is to inculcate in the pupil the habit of using thought effectively in dealing with facts. The pupil may get the facts from a few good books, but he will not get the habit of straight thinking about them from few or many books. He must have a real teacher if he is to comprehend real science.

"If the scientific attitude is not acquired in high school, it is rarely attained later, and every university teacher will support the statement that it is the ability to think straight rather than the storage of any amount of information, which determines the

"As to the methods to be pursued, the writer expects a wide scattering of opinions—which is, of course, as it should be. The strongest teacher is he who most clearly and constantly visualizes the end to be attained, and who most successfully evolves and adapts his methods in accordance with his individual powers and the needs of his particular pupils. Ends should be agreed upon; means should be individual."

There are, however, Mr. Frost believes, certain general assumptions in the teaching of science which, altho widely accepted, are too seldom clearly exprest. Three of the more important of these might well be listed in categorical form. Here they are:

"1. Scrupulous maintenance of a scientific attitude on the part of the teacher, and avoidance of 'scientific' dogmatism. Any teacher who is afraid to say 'I do not know,' is more dangerous than useful in a science department.

"2. Every statement, question, and answer, of both teacher and pupil, should be accurately and completely exprest. Any loose wording should be attacked and criticized by the class, and so amended as exactly to express the thought intended.

"3. Every opportunity to ask 'Why?' should be utilized. In modern educational parlance, the 'heuristic' method should be employed.

"Every reader of this article will wish to add to this short list, and the writer desires to exercise the same privilege. He would include in it

"The adequate presentation of the fundamentals of logic in every science class.

"This should embrace the study (not the mere memorization of definitions in the first chapter of some text-books) of axioms, assumptions, hypotheses, theories, laws, syllogisms, fallacies, and the validity of generalizations. How many students in any senior science class know and can state what they actually mean by the phrases 'I guess,' 'I suppose,' 'I believe,' 'I think,' 'I know'? How many know what factors justify a generalization, or are able to detect common yet plausibly worded fallacies? Yet a working knowledge of these things lies in the very foundation of scientific thinking. The obvious outcry against such an innovation is that logic can not be understood by most adults, and that it is therefore absurd to teach it in high schools. To which one is tempted to retort that if the adults had been taught something of logical scientific thinking when they were in school, they would now be able to understand more of logic, and many other things. The real answer is that it is actually much easier to teach practical logic to a high-school pupil than to an

Mathematics a Tool, Not Goal, State School Survey Reports

Should Prove Key to New Interests, It Is Declared—Younger Pupils May No Longer Be Harassed by Long, Confusing Problems Their Elders Faced

Strictly utilitarian mathematics courses in the public schools of Massachusetts should in future be regarded as tool courses and not in themselves cultural or intellectual.

Such is the opinion of the committee on a course of study in arithmetic for the elementary grades and the committee on a course of study in mathematics for the junior high school grades working under the steering committee on curriculum revision of the Massachusetts Department of Education, which have just made their first preliminary reports. This marks the first official application of the new theory of mathematics in the schools of the State.

While it has been found convenient in outlining a new course to classify the material as algebraic, geometric, and arithmetic, it is to be understood that the branches of mathematics are to be frequently correlated so that the pupil may see arithmetic, geometry, and algebra working together to solve problems, to illustrate them and to explain them, the committee on mathematics in junior high schools, states, making radical departures from the traditional classic method of handling those subjects.

Correlated With Experience

It adds: "We are free to make use of any mathematical material which will assist in the present mental growth of the pupil and which may be of value to him in his future experiences as an adult. Our view here should be broad enough to contemplate our pupils' going into the world better able than their predecessors to use mathematics, and able sometimes to improve the mathematical practice of the community."

The pupil should be led to think of mathematics as a tool, the committee insists. Instead of being unrelated and abstract, he should recognize its usefulness in home life and in a wide variety of occupations, in business, in industry, in general science and in the arts; as connected with his own experiences and those about him and that it gives him power to do things which are worth doing now.

He should think of mathematics as a most important type of thought; as the way that the world deals with its quantitative situations, and hence an essential part of an all-round education; as a systematic method of dealing with data, as a universal language and an exact method.

Educational and Vocational Guide

He should be led to see that man's mastery of nature depends upon quantitative knowledge, that is upon mathematics, and that this is true, whether in the days of the building of the pyramids, or in the days when Columbus sailed an unknown ocean, or in the days of modern structures and engines, of radios and automobiles.

He should be led to a desire to discover his own strengths and weaknesses, his interests and aptitudes, and so to receive guidance both educational and vocational; he should appreciate skill and be dissatisfied with low mastery when high mastery is important. He should desire accuracy and come to have the habit of assuming responsibility for his own work and of judging all results. He should expect to grow in number judgment, in accuracy and in power."

These results which were highly desirable in the old method were seldom a conscious aim on the part of the teacher. In the new curriculum mathematics are to be distinctly recognized as a means which the pupil is to learn to master precisely as he does any tool in the workshop, that he may need in the construction of some piece of work. With the change in point of view the pupil is expected to have nothing of the old antagonisms, but to accept mathematics eagerly as a key to new interests.

Path to New Attainments

Incidentally, the pursuit of mathematics intelligently leads to the attainment of definite, practical ends, and is expected to develop any number of desirable attributes, such as the attitude of investigation and exploration, the habit of understanding, habit of reasoning, self-confidence, public-mindedness.

Many topics in arithmetic previously taught in the elementary grades are to be eliminated as having no social value. In future instruction is "to serve a socially useful purpose as well as aid in the study of higher mathematics."

The long, confusing problems in fractions, partial payments, true discount, ratio beyond the ability of fractions to satisfy, partnership with time, longitude with time, the various tables of weights and measures, trapezoids, trapesiums, polygons,

lt. It is easier to walk straight across an untrodden field
n it is to do the same across a field worn with many crooked
hs. A study of the fundamentals of logic does not necessarily
ply stilted phraseology, abstract theorizations, nor the
dieval clap-trap of the word-juggler. It may be taught (best,
haps) with the aid of material taken from the Sunday paper,
a basis for critical discussion.

"That the child's mind is inherently more logical than the
nd of the adult is a fact observable and provable by any one.
at we allow it to remain a fact is the most terrifying indictment
our educational system."

frustrums, spheres, cube root, and the metric system, are no more to fret and harass the children.

Research and experiments in the study of arithmetic which have resulted in the new interpretation will continue for some time to come. The committee is not ready to offer a definite course in arithmetic but quotes from the Fourth Year Book of the Department of Superintendence of the National Education Association, a statement with which it agrees as follows

"Young children are interested in numbers just as they are interested in language. They get number concepts through their everyday experiences. The number work of these grades has for its major purpose that of developing number concepts through broadening and enriching of the experience of children. Measuring, weighing, counting, buying, and experiences in general with objects and money, are the ways by which the number ideas are developed and made clear and definite. The work of these grades should make clear those th'ngs which children do normally with regard to numbers."

Quotation from H. E. Pigott's "Introduction to Music" Jr. Dept. p. 8. "Many educational theorists hold that there are roughly three stages by which we mount to a complete theoretical knowledge of a subject. There is an exploratory stage, in which interest is aroused and a number of vaguely differentiated impressions received. In a second stage, coupled with further exploration of the matter, comes also organization;

categories and rules make their appearance, and a nomenclature has to be understood and learnt. In the third stage, generalization is made complete; everything is put into its class, and the classes are all completed".

Continuation of note on course ~~from~~

As an exercise, name a quality of certain objects and have the pupils arrange & grade the objects according to this quality. Vice versa, show them an arrangement of objects and have them name the quality (similarity) which governs the arrangement and its order of arrangement (kinds of difference)

Grading is a grouping & sequence a/c to quality.

6 Reasoning sequence show differences within a likeness. ∴ Good in perceiving & forming smaller & larger or lower & higher unities and relations. of Boole.

0 Into this scheme facts & knowledge fit in

& are held together by the relations perceived. The formal, academic, refined, new stuff & necessary for university work is introduced later, after the instruments of perception & conception have been developed & trained & [redacted] a bit. This scheme supplies motivation also. Curiosity & aesthetic interest; relief, as a result of the increasing sense of order in all nature, sense of relationships & at least potential unity. Utility motive also. Fit well with school work & general knowledge. May use history for examples of cause & effect.

Develop realization of connection between quantity & formation or quality & usefulness.

Causation is ~~not~~ really a relationship involving change of space & time relationships, also repetition & consciousness of uniformity, also underlying of relationships in repetitive series of events. Therefore an adequate understanding of causation requires training in space & time relationships. And until this understanding of causation is

developed there can be no real grasp of physical laws.

As units for arrangements use squares & triangles of sheet metal or wood, buttons, cubes, stones, grains, sticks, wires of different short lengths, mechano set, beads (small & large), colored string, colored squares & O of cardboard

Initiative plan.

I Large & small

1. Separation of large from small.
   A. Give each a handfull of grain & have them grade it by size, into 2 piles. Grade apples, nuts, quinces, lemons, peas.
   B. So with earth - separate out small by shaking
   B2. Count number of little leaves & big leaves on a plant
   C. Write down names of tallest boys & shortest boys in 2 upper classes.
   D. Name of small towns & large towns in 2 villages
2. Combination of large & small into units or larger wholes
   A. Put together some big sticks & little sticks into a pattern
   B. Name some work done by children closely pattern that consists of putting together things to make a bigger whole. e.g. cooking, making clothing, building a house, making a basket, raising a crop.
   C. Comment & questions on both - uses, examples.
3. How to measure. Semi-metric
   Devise machines or devices for grading.

II Shape - curved or rounded & straight squares or angles

III. A. Separation or analysis.
   1. Pebbles
   2. Plant leaves
   3. Cardboard & metal shapes
   4. straight & curved wires
   B. Synthesis
   1. picture puzzle put together - curved
   2. make pattern with invisible curved & angular lines & wires one pattern
   3. name sets that are pretty curved & pretty angular
   4. same with plant leaves or blossoms.

III. ~~Color~~ Light + Dark.

A. Separation
1. Names of light colored + dark colored flowers, ~~or~~ trees, birds, insects,
2. Stones
3. lists of wood, book + paper + cloth
4. Number of black sheep or cows + of white ones in your village

B. Synthesis
1. Make pattern of alternate black + white buttons or lots of cardboard
2. ~~make pattern~~ Do you know anyone with a cloth of white + black or dark + light pattern
3. Name some cars of black + white

IV. Color - continued

A. Analysis
1. Name of bird with 2 or more colors - name the colors of each
2. Name of flowers .. .. do separation
3. " " insects
4. grade apples by color

B. Synthesis
1. With colored crayons make pattern with 2 colors
2. Repeat with 2 other colors
3. Name all the colors you know

C. Games involved

V. Color - (harmonious) shades

A. Analysis
1. Names of flowers with 2 shades of same color or more colors at once
2. Insects green,
3. Trees with different shades of green.

B. Synthesis
1. ~~Pattern~~ Make pattern with different shades of green, red, etc
2. Name instances of 2 colors together

VI. Weight

A. Analysis
1. Separate stones - above + below 1 oz.
2. Weigh out + pile of grain into 1 oz, 1 oz, 3 oz + 4 oz piles
4. ~~[illegible]~~ Name kinds of wood of to cut.
5. Name young ones with milk, + litter milk.

B. Synthesis
1. make a balance

C. Measurement ~~[illegible]~~ units, scales, standards
problems.

VI. Sound.

A. Analysis
1. Animals, with high, shrill calls, or low
2. " soft, loud – Birds
3. musical instruments of both kinds

B. Syntheses
1. animals making both high, slow, soft, loud sounds.
2. Imitations of patterns – whistle, flute, singing
3. Use human voice, drums, whistle, make a flute, a wood drum, instrument.

C. Measurement.

D. senses involved

VII. Time.

A. Analysis
1. ~~[illegible]~~ quick events – lighting; wink of eye, tick of clock
2. Slow events – yr, day
3. Quick, slow related work.

B. Syntheses
1. Drum rhythms. Have each boy show examples of each ~~a pattern~~ with stick on floor
2. Rhythm patterns slow, fast on drum.
3. Name all divisions of the calendar
4. Name all units of measuring a relating time.

VIII. Time & space (movement) units, units, problems. Make a sun dial, a pendulum.

A. Analysis
1. Classify animals into slow moving, quick moving
2. Same with birds — stars, sun, which goes fastest.
3. Insects
4. Name of quickest runners, element in school or in village
5. Fast workers, slow workers

B. Syntheses
1. Imitations of slow after quick movements, vice versa.
2. Imitations of combined slow, quick work.
3. Make a sundial, record movements

C. Measurement. Drums, ft per min.
Senses involved.

~~VIII~~ IX. Length.

and 1. Name tall, short trees, boys
2. Group, lines, unlike sides of polygons
3. Concept of point, of line, drumming
Syntheses. 1. Patterns of long, short lines. Drum lines
2. How long is [illegible] by pt or by intersection of planes
Measurement. units, yardsticks, standards.

IX 1. Length of curves circle, ~~[illegible]~~, ~~[illegible]~~.
IX 2. Angles

X. Wt & Time (work)

A. Analysis 1. minds which can carry opt wt short distance
2. Wills carry distance.
3. ~~Problems~~ Sight loads only

B. Synthesis & measurement
1. Foot pounds
2. problems in work

XI. ~~Wt & Color~~ Temperature
Amal.

synth. 1. temperature records kept

measurement.

XII. Sequences in space.

Position or intro analysis (idea of 3 dimensions; Cocc)

XII a. Sequences in time.

XII(b) Counting

XII c. Sc

XIII. Areas: squares, rectangles, parallelogram, triangles, circle, ~~[illegible]~~ regular 5, 6, 8 polygons, irregular polygons.

Analysis: 1. Take wire models to pieces. Names of parts.

Synthesis 1. paper folding
2. Use of sequences of metal
3. use of ruled paper.

measurement 1. ~~problems~~ units, scales, standards
2. ~~[illegible]~~

XIII 2. Finding units in separate difference. Fix a group of different shapes different material objects cut all of same length & have children find the units. Find in first of common color in different shaped objects. Try another a separate set — the common units.

Sense perception

XIV. Volumes. Cubes, oblong, prisms (△ □ & ⬠), cylinders, cones, spheres, ~~irregular solids~~, wedges, irregular solids,

Analysis.
1. Volumes of each
2. Names of parts
3. Taking models apart
4. Concept of 3 dimension

Synthesis
1. relation of parts
2. clay modelling
3. paper folding

Measurement
1. of each. - relation to analysis & synthesis. Units from little cubes.
2. Problems.
3.

XIV (a) Symmetry about (1) point
(2) line
(3) plane

XV. Smell.
Analysis
1. Kinds & intensities. Name examples pleasant & unpleasant. Associations & uses
2. Tests with bottles

XVI. Taste.
Analysis

Synthesis
1. practice grading apples etc by sweetness,

XVII. Touch. (hand & tongue [effect qualities])
Analysis. Insulators discernable. Blind people rough & smooth, hard & soft, elastic & non elastic, big & small, ~~heavy & light~~ (heavy & light)
Synthesis. practice in grading by different qualities

XVIII. Cause & Effect

~~XIX~~. Probability.

XX Sound & tones (music)

XXI. Complicated grading f/c to practice & qualities - cattle dung, grains wool, etc, clothing

sizes & weights & quality, handicrafts for plants, ~~[illegible]~~ wds, also, etc.

Apparatus needed for above.

Buttons, black rubber one, large & small; sheet metal squares 1 sq. in. & 1 sq. cm. sheet metal 45° triangles ½ sq. in. & also 60°-30° triangle; cut paper for paper folding experiments, iron copper wire, plasticine, 2 more sets of lb wts (1 more set of ag wts), colored wax crayons, shells of cardboard, beads large & small a different colors of each size, 3 sizes; part of a mechanics set, erasers, more squared paper. Make large abacus for use in making patterns & illustrating sequences!

Some problems in increasing accuracy:
Relation of accuracy to result desired or kind of work.
Relation of accuracy to sources of error (a) in nature of material (b) in unit standards available (c) in our senses.
Bring in idea of accuracy for each topic.

What advantages does above plan have over conventional one? Novelty & ∴ greater chance of interest & attention; more synthesis & ∴ more interest; ~~tedi~~ difference between analysis & synthesis made clear; idea of relationships & order & cleanness & neatness

training of instruments of perception & conception before developing concepts of law, order, sequence, cause & effect

made more clear. Whole concept is analytic. Bring out use of senses. More conscious training in discrimination, in classification, in judgment, in measurement, in accuracy, in manipulation, in instrument.

Train instruments of perception (senses) & ∴ give clearer percepts & ∴ better basis for clear concepts. More development of aesthetic sense. It does not begin with the complex ideas of forces (gravity, inertia etc) but with simple sense elements & elements of space & time. Gives better basis for geometry. Well adapted to individual work. Simple. Not expensive. Psychologically sound in relation to ideas of Binford, Rivals, Kant, Montessori, A. Gloss, Holmes, Dalton plan, Boyle, Opaly, Pestalozzi, Montessori, Hinton.

Defects as it stands. Not enough use of familiar things, not enough discussion of accuracy, not enough manipulation, must ~~see~~ come to understand relationships & get sense of presence of relationships by use of senses, by manipulation. Perhaps not enough ~~problem~~ practice. See how long it will take. Make sure that idea of unit of measure of each is developed out of sense involved & its accuracy. Trace history of measurement & early standards. Differences in different countries. Does it present things to them in sufficiently familiar way? Is it useful enough? Not enough ~~attention~~ practice in seeing similarities in apparent disorder. Use more diagrams & squared paper. More ~~practice~~ for curiosity & wonder.

Is it sufficiently [illegible]? Not enough practice in seeing (a) differences & (b) similarities. It get confused with the probability.

Utilities, if any, must be related to the people's industries, ~~agriculture~~ raising of grains & fruit, use of wood & stone in building, of metal in blacksmithing & tools, use of water, foretelling weather, oppressions & exactions of great local & imperial, growing of wool, spinning & weaving of wool, cutting & sewing cloth,
land measurement
keeping smith

An opening in logical order (e.g. relation to size, wt, color etc), functional order (noting out uses of objects), historical order, space relations (size or shape), in a sequence of order, in recurring sequences.

Give talks on tools, qualities of metals, care of tools, sharpening. Get U.S. Bureau of Standards book on ~~[illegible]~~ household standards & give talks on ~~[illegible]~~ testing of material before buying. Have a section on strength of materials - wool, cotton cloth, cotton thread, on qualities which go to make up good cloth,

Problems ~~in~~ training in accuracy of counting & of measurement, ~~of~~ specifically of measurement of land, of grain, of standing & fallen timber, of raw
climates

wood, of cloth, of stone, of weights, are all utilitarian.

Having to make instruments for measuring & for grading will teach them to face new situation, to analyze it, to utilize elements & qualities & see their relation to function.

Other specific utilities will be the practice in classifying & grading & testing grain seeds, apples & plants, trees, cows, wool, cloth, thread.

Have several experiences in purification or cleaning. Eg. filtering water, separating chaff from grain, cleaning up rubbish, cleaning ice from dirt & sand. Health as internal & external cleanliness. Water & its uses by other drawing away puddles of water. Discuss relation of cleanness to order, to health. Discuss fire hazard for cleanness & other things that mess up our sense of order.

Develop ideas of different kinds of order — natural, spatial, functional, logical, formal, ~~etc~~, causal.

Each unit of work should ~~[illegible]~~ analysis, synthesis (one sensory & manipulative, another mental or symbolical or description & by name), measurement, accuracy, noting of first differences & then of similarities in a given situation or arrangement of objects, function objects, function relationships. ~~[illegible]~~

making a standard of quality or unit of measurement

References or instances of applications in the West or in the plains. Problems, arithmetical or manipulative or involving relation of quality to function or use.

Tyndall's game of observation & memory of a number of objects in a tray after looking for one moment. This does not train sense of order, harmony.

Hinton speaks of the great pleasure of finding that ~~[illegible]~~ thought & outward reality correspond — re his system of marbling, cubes & eight-ly, tho it seems very formal to me.

A possible advantage is that in training the mind to order & arrangement it also trains idea of ~~attitude~~, so important in morals & religion. And it does not go in for or require a background of machinery, or of material power.

Cf H B Clifford on Scientific Thinking.

How about analysing & synthesising motion also? Cf Boyles tangent cross

The analysis & synthesis or sensing of (1) contrasts & differences and then (2) similarities in each pair of operations should ~~be so~~ deal so far as possible with the same elements. Put mind first into state of tension & then of rest & satisfaction. Cf Boole & Spatty.

Try to have either 8 different experiences in each unit or at least 8 sets of objects for each experience.

~~How does~~ How far does it satisfy Holmes 5 or 6 instinct groups? Aesthetic, scientific, expression, How then observe arrangement in nature, leaves, flower petals, seed pods, cross sections, feathers etc.

Apply Bose's ~~Bangalis~~ principles of plant stimulus.

Measure changes (of position, of quantities, of qualities, color, tone, vol. of sound, smooth to out of light, rough touch, soft to touch, intensity of smell, i.e. movement, increase, decrease, change, growth, as well as static arrangement. Changes in temperature, in light, in position of sun, moon & stars, in height & wt of plants, in root development. Correlate with math formulae (?) in rate of movement of insects,

Let the child wonder

Through position (sites) analysis & clock get idea of space + time well in mind.

Center the practical work around the operations of producing food, clothing + shelter (including beauty in each all). E.g. ~~acting of~~ recognition of + practice in creating order + arrangement + laws + rules in relation to grain, animals, milk, glue, manure, soil, fields, irrigation water, weather; wood, stone, building, architecture, masonry, carpentry, carving, strength of materials; sheep + cattle + goat + breeding, qualities of wool, strength of yarn, spinning, weaving, calling out cloth, sewing, patterns, designs, proportion, dying; cooking. Application ~~to these values~~ of heat, light, mechanics, statics, electricity, magnetism, sound, taste, touch, smell to the above practical + familiar realms of life.

Cite differences in food, clothing, shelter + carrying + moving by different nations + peoples as examples + present. E.g. difference in clothing in heat, wind. In housing,

After they get used to idea of relationships + sites, time chart, try to see each thing in relationships in relation to familiar things, because in child's mind time is great number of repetition of events

Chap 38.

Quotations from "Science & Modern Thought" in vol IV of "Outlines of Science", by J. A. Thomson. p 1161

"The establishment of a science depends on processes of selection and detachment, what might be called 'isolating certain aspects of things'." --"Science begins when, from a great number of experiences, one general conception is formed which will embrace all similar cases. Science means unifying diversities and detecting uniformities." --- "We explain an event not when we know why it happened, but when we know how it is like something else happening elsewhere - when in fact we can include it as a case described by some law already set forth."

--- A law is, resumes, in a few brief words, the relationships observed between a vast range of phenomena." --- "Science aims at the formulation of things as they are and as they have come to be." --- Science "does not" ---

The scientific mood --- is marked by (1) a passion for facts (this includes a high standard of accuracy and a detachment from personal wishes); (2) a cautious thoroughness in coming to a conclusion (this implies a persistent scepticism and self-elimination in judgment);

(3) a quality of clearness (which includes a dislike of obscurities, ambiguities, and loose-ends); and (4) a less readily definable sense of the inter-relations of things, an insight which discerns that apparently isolated phenomena are integral parts of a system." ----

The methods of Science

"In any scientific inquiry the first step is to get at the facts, and this requires precision, patience, impartiality, watchfulness against the illusions of the senses and the mind, and carefulness to keep inferences from mingling with observations. The second step is accurate registration of the data. In most cases science begins with measurement. ---- A third step is arranging the data in workable form — a simple illustration being a plotted-out curve which shows at a glance the general outcome of a multitude of measurements. --- The data may have to be expressed in their simplest terms, reduced perhaps to a common denominator, with other sets of facts with which they have to be compared. ---- The fourth step is when a whole series of occurrences is seen to have a uniformity, which is called their law. ----

"The laws of nature are man's descriptive formulae of uniformities of sequence, which enable him to say, 'If this, then that'. ---

"The various sciences differ greatly in their degree of precision." (Physics and anthropology)

School Algebra — by A. G. Cracknall
7 s. 6d. with answers.
printed for expulsions, especially on graphs, by
Dept of Educ. & Nutt Gazette
University Tutorial Press Ltd
25 High St Near Oxford St London
WC2

Agents in India — Indian School Supply Depot
309 Bow Bazar St Calcutta

(continued)

6 "Science is a system of knowledge built up on a basis of observation and experiment, and compacted by reflection on the data thus supplied."

3 Cf. General Note Book III. pp for quotation, and concepts and their relation to sense impression. Also cf math text book on importance of concept of unit standard for measurement. Cf also Halstead in his chapter on measurement & order. cf

7 After learning areas, give growing areas by increasing 1 or more of the controlling dimensions, & plot curves of the results. Same with volumes.

0 One of the most important areas of culture contact between E & W is in the field of science. What is to be the attitude of the E toward W science? Therefore this proposed introductory course in science for Indian village children may be of very large importance. ∴ Cf Gandhi's essays on Natl Education, on concepts, on Evolution, on Materialism, on Yoga. He knows E & W literally. See also Tagore on education. And Gandhi's comment on my letter to him.

Use also ideas of Mach, Kant, Pestalozzi, Bramford, Holmes, ~~etc~~ Dewey & others.

Write an introduction addressed to teachers, explaining the reasons & methods. Continue Kitchen Room.

How about natural history & habits of flies & some grain just inserted. Describe process of digestion & right foods.

The order of arrangement of these experiences should depend partly on their interest, partly on the ability of the child's mind to grasp it, partly on its intrinsic sequence of difficulty or order, partly ~~on~~ ~~to~~ reference to the time to be devoted to the whole series & the relative value of each experience to the aim desired.

Infuse some history of Hindu science.

Group much of it around radiant solar energy. Quote Upanishads & Gita, Ramayana & Mahabharata as source of all. This will tie up

of Fairgrieves Geog. & World Power & Soddy's Cartesian Economics & Gamble.

well with Religion & agriculture. A second group around life, climate, ~~wood for death~~ power (coal, oil, wood, water, ~~wind~~) as products of solar energy plus life. W & water power minus the life. Comparison between food for machines & food for bodies. Show that what is not used by one kind of life is used by another, e.g. manure, CO_2, Concept of uncleanliness & cleanliness: as simply order fitted to functioning of life. Show life of fly & of mosquito & germs, as living on what we cannot use. Idea of cleanliness as guiding life into higher forms, not as a killing.

In Spring work out a syllabus for the arith (& geometry) of 1st 6 classes on basis of Halstead, Branford, Dalton plan, Nash, & Art of Arith book, Brooks, & Gardiner & Hill environment & needs, & preparation for the 4th & university.

Two main concepts for children to get are order & comparison. From order comes arrangement, space, time, association,

skill in manipulation

physical law, observation, accuracy, From comparison comes ratio, measurement, accuracy, skill in manipulation, & a reinforcement & quickening of order.

For manipulation & development of units concept use paper folding & drawing on squared paper. Have them make their own measures by learning to bisect & trisect lines, to make square figures all with paper. Also protractors, plumb lines, levels, survey instruments; develops hand measuring by squared paper earlier.

Sand measurement & rod selection are the two best practical developments for science in India, to be followed by cattle judging & sanitation (especially flies).

Work out sets of different length lines going on series, e.g. 1, 2, 4, 8, 16 & or, 1, 3, 9, 27,

or by factorial numbers, with repeats. Similarly with areas and with colored squares or circles of cardboard of say 4 different shades of each color, with repeats. Have them arranging in recurring series, (or with mixed squares □ □ □ □ □ □ etc. Then, for comparison, give them mathematical series & recurring decimals as expressions of similar "laws" in mathematics, e.g. $1+\frac{1}{2}+\frac{1}{4}+\frac{1}{8}+\frac{1}{16}$ or $1+2+4+8$. Both Geometric and arithmetic progressions. Introduce ratio early for same purpose.

Use playing cards for showing sequences. Horse chestnuts for big beads.

Do some exercise in copying (sentences, figures, designs) for practice in accuracy, speed, neatness, thoroughness. Repeat 4 times. Course both observation & production. Tell them what it is for. Might do it every Saturday, say for a month.

Develop use of Boxe instruments:

Note Clifford on Sci thinking & technical thinking & the diff betw

"Pure mathematics is exact because it rests on mental concepts which, from the very constitution and operation of the mind, can neither vary nor be impugned. It is in reality a repetitive process of verification, for, however involved, every conclusion is more or less given in the premisses. If the proposition be truly understood, and the appropriate formulae known, the conclusion must inevitably be reached and be the same for all minds capable of understanding."

From an article on Psychology & Crime in Oct 1926, "19th Century."

Causation involves uniformity of recurring sequences of both space & time, — along all four coordinates, i.e. of events. This is "propter hoc." Sequence in time "post hoc" (without invariable uniformity upon repetition) a sequence only in space makes what is a sequence only in time is called a "pattern" or "design". Causation not only implies a sequence involving all 4 coordinates but also a repetition thereof in uniform manner often enough (in relation to commonness and times) to give an inference of strong probability of invariable uniformity of repetition. Also the details & order of the sequence must be known to constitute causation.

SUMS WITH A PURPOSE

A Study of Motivation in Arithmetic: Results of Inquiry in U. S. A.

NEW METHOD OF TRAINING CHILDREN

In the preface to a pamphlet entitled "The Motivation of Arithmetic" recently issued by the United States Bureau of Education (Washington, D. C.), writes a correspondent to the "Times Educational Supplement." Mr. J. J. Tigert, United States Commissioner of Education, points out that when working out problems of teaching practice it is helpful to collect and publish solutions devised by successful teachers. This method of pooling experience was illustrated in a bulletin published by the Bureau on "Games and Other Devices for Improving Pupils' English", and was so enthusiastically received by teachers that the Commissioner asked Mr. G. M. Wilson, Professor of Education, Boston University, to make a similar study of motivation in arithmetic. The resulting "bulletin" is based on answers received from about 5,000 teachers throughout the United States.

Mr. Wilson points out that leaders in education have for at least a generation accepted the idea that the formal "subject matter" view point is not only inadequate but in many respects deadening, and that the child and his interests must become the centre of school work. The properly trained teacher understands the larger purposes of school work and the fact that learning takes place effectively only when the child is thoroughly in the game.. The human machine is different from a gasoline engine; it asks "why". It wants to know the reason, it wants to see the relationship of each new thing to something known. The old notion that the child can learn to-day and understand at some future time has been abandoned, because psychology is against it.

The teacher who says she does not have time to wait upon child needs, or to give attention to them when they appear, is missing a fundamental consideration of the educative process. Rather she should say, "I cannot go forward without considering children's interests, their purposes and their life activities." This is the true view. She 'cannot' go forward without it. She may carry on a mechanical process, but little or no true education results.

A careful study made of the returns shows that thousands of American teachers are making a definite effort to realize the principle of interest or motivation in their work, but that in spite of these efforts much of the work remains formal. "Actual life situations are not very common in school work." The most common means for holding attention is the game or game device. Some games are used in all grades, but more in the lower grades, and many teachers regard the bringing in of life situations as an intrusion on the regular work. Mr. Wilson suggests the following rules for elimination in exercises to be performed by children:—

Omit material unless it appeals to the children as worth while, useless its use is evident. It may serve a useful aim in general without being useful to the particular group of children.

Omit material not within the comprehension of the children.

Omit material not appealing to the interests of the children.

Omit material not connected in some vital way with large problems or activities of the children.

Omit isolated details.

Object Lessons

Some actual "life situations" reported by teachers are as follows:—Weekly personal accounts; keeping the milk account for the school; window boxes for the school; planning a picnic lunch; planning a school garden; a school savings bank; planning and buying wood for carpentry; reading scale drawings; estimating quantities of material required for clothing; using an individual recipe for 30 persons; changing a cake recipe which will provide 12 helpings to one which will provide 18 helpings; working out the results of a spelling test; guessing height and verifying; noting attendance.

"Play-like" situations based upon actual life situations and connected directly with pupils' present interests are more common. The idea of a school shop has been widely accepted. Special sales as advertised through the newspapers are used freely. The furnishing on paper of a room, or a home, the making of a family budget, the imitation bank, and the building of a home—these and other exercises are modifying school practices in the right direction; the school imitations are accompanied by a study of the actual situations in the community; the children are brought nearer to reality. Laying out small sums on imaginary Christmas presents, with the aid of a catalogue; or planning imaginary dresses to be made and hats to be trimmed within the limits of a small dress allowance; imaginary furnishing of houses—all these have a personal appeal. An exercise of value consists in learning how to buy in order to have a better quality of food or the same quality at less cost. Another topic is gas—How is it manufactured? How is the meter read? How are gas bills computed?

Method of Teaching

Children are encouraged to note down arithmetic problems which they meet outside the school or in the home, and during the arithmetic period the problems are discussed and solved. To make real the topics, "What the Government does for us" and "How it is supported", groups of pupils visit the following departments of the city for information as to actual expenses of the current year:—Fire department, police department, public library, electric light company, secretary of board of education, street-paving department, commissioners, and hospital. The information thus secured is used in making a series of real problems. Pupils are appointed to positions in the bank and several are appointed landlords. The rest of the class make out cheques payable to the different landlords. They, in turn, give receipts in exchange for the cheques. Then the landlords take the cheques to the bank, where they are examined to see if they are made out correctly, and money is given in exchange for them. Material, such as old cheque-books, samples of notes, and deposit slips, can easily be obtained for use in the schoolroom, which is arranged as nearly like a bank as possible. Each member of the class selects certain stock and calculates gain or loss on 50 shares if the stock is bought on Monday and sold on Saturday of the same week, using the daily newspaper stock quotations. If a pupil's father owns the house in which he lives, it may be pretended that the father has asked him to take charge of it for a year. A small committee may be appointed to visit a local insurance agent and find out upon what the insured value depends, the rate &c., and to get a blank policy form.

In studying taxation a committee is appointed to visit the collector. The chairman of the committee reports, and five assessors are appointed to make out the tax list. Each pupil, acting upon this information, makes out his own tax bill, and they all go to the pupil who has been appointed tax collector and pay their taxes. Cuttings from newspapers are used showing how the city is spending money, and pupils are asked to observe the new tax bills which their parents receive.

Games in which calculation is involved are numerous and Mr. Wilson's 5,000 teachers have sent in some ingenious variants for children of varying ages. For young children score keeping in such games as throwing a ball at a target, tossing a ring from hand to hand, and so on, teaches rapid counting, while keeping them interested and on the move. Games of postman, with quantities of letters and postcards, games in which each child is known by a number and has to tap it on the door and be recognized before he is let in, or must quickly take his place in a line—these are only a few among many, all of which have the advantage of being more active than the card games and domino games by which the average child gets familiarity with numbers on winter evenings at home. For older children there are such games as "cross-questions" by competing teams, and relay races which involve working out a sum before running back to the starting point. Many of the devices described are extremely ingenious, and all are of a kind to appeal to young people's sporting and competitive instincts and to improve their mental and often their physical agility.

ALLAHABAD TO PRESENT ADDRESS TO VICEROY

Municipality Passes Resolution After Hot Discussion

ALLAHABAD, Oct. 21.

A meeting of the Allahabad Municipal Board was held this evening, with Mr. Nurul Hasan, the senior Vice-Chairman in the chair, to consider the question of presenting an address of welcome to the Viceroy during his visit to Allahabad.

Mr. C. T. Robbie moved that an address should be presented and that a Committee should be selected to draft it.

Mr. B. Sangam Lal (Swarajist) opposed the motion saying that the Viceroy had not proved himself deserving of an address. On the other hand, the Government of India had done nothing to prevent the gradual removal of the capital from Allahabad to Lucknow nor had it come to the help of the Hindus in connection with the Ramlila celebration, of which the Hindus had been deprived by the action of the authorities, and the Hindus were not in mood to present an address.

Dr. Basu moved as an amendment that the address should contain a relation of their grievances on questions of the capital and music in front of mosques.

A number of speakers declared themselves in favour of the motion but Pandit Kapildeo Malaviya strongly opposed it, contending that he owed it to themselves and to the country that, so long as their grievances remained unredressed, no address should be given.

It was eventually decided that an address of welcome should be presented but that it should not contain a reference to the grievances about the removal of the capital. Three members opposed the motion of an address.—Associated Press.

INPERIAL BANK WEEKLY R

CAL

The Imperial Bar
show that during
15, the public depo
5,64,90,000 to Rs. 1
deposits decreased
81,18,51,000. U
returns show th
October 15,
vestments de
loans by
credits increas
bills discounte
75,000 and th
7,35,41,000 to
The Bank
at four per
is 43.75
creased by
Press.

using space. Always write Ans. after answer, & underline it. Always express the name of unit of the answer, if it is in any sort of measure. No doubled equality signs, e.g. $ab = ba = \frac{b^2a}{b}$. Always make rough check, at hand.

write clear & plain figures, and in whatever rules will make them easy to read.

Have the 6th class learn meaning of these English mathematical terms:-

add, subtract, multiply, divide, addition subtraction, multiplication, division, multiple, factor, dividend, divisor, multiplier decimal, percent, percentage, quotient, remainder, {sum total, average, profit, loss, relation, place value, unit, digit, plus, minus, product, numerator, denominator, fraction, ratio, angle, area, volume, height, width, length, base, breadth, square, triangle, parallel, rectangle, right angle, check, verify.

& correlate with different colors as affecting absorption of Direct chlorophyll.

Correlate also with cloudiness & time of day & time of year. Clouds for color.

See book on plant physiology. Plants being anchored are simpler to study & we can get whole life history better. Biography of a plant is very full of interest.

Plant growth & physiology as one centre of the course. Basis for origin, for nutrition, for personal physiology, for use of heat, light, structural strength, adaptation.

Heat & light correlate with religion & origin & chemistry & all life.

Use plant growth as basis for measurement of change. & structure of wonder & adaptation

Explain wave motion & radiant energy only.

3d is the analysis & synthesis movement, selection, grade, & relationship.

Try to make some Bros instruments, cinematographs etc. Plants also teach unity of all life & climate.

Correlate with growth of crystals of salt & sugar.

Look into book on Scientific
reading in Science

See "The Meaning of Meaning"

approach of what significance is
the order (cause), regularity, relationship
sought for in science. It's principally
relating to the utilities of space & time.

Begin with descriptive charts
light & heat & growth — & work into analog
& synthesis, using measurements to
~~change~~ carry over from one to another

How all our power is from sun.
Introduce W. machine, then its
~~power~~ of stored power. Put on body
similarly. Study ideas of lever from
our bodies limbs. Also all other machines

Price mechanome in piano.
get an old cheap clock & use
pendulum & work out an open
~~for~~ works time. Also a water
clock & hour glass

Most nature study seems too much
playing on the wonder & aesthetic elements
also too much drill learning from teacher & not
enough sensory testing, comparison, measurement
& arrangement.

Use leaf, root & fibre structures. Use
microscope to play on sense of wonder & beauty
Develop aesthetic atmosphere of interest
Growing plant gives good example of measurement
& induction. Change of length vol wt, color, shape
make sketches of shape, weight to work.

How about using lens point rays to get records of the of shape & size.

To introduction for village sci. book, add a list of days books for village sci. teachers. Also note that altho first few months of the course are not "practical" that is not true of any entirely new subject. Note that in the English language the words important to science — "order" "arrangement" "regular", "law", etc. either did not exist in early days or were used in an entirely different sense. Therefore these sci. concepts must grow slowly. In early days magic & spirits ruled. Child's mind must follow development of the race.

Hodder & Stoughton's "Peoples Library" —

"Everyday Biology" by J. A. Thompson 2/6 s.

"Atoms & Electrons" by J. W. N. Sullivan 2/6 s.

Home University Library Series Rs 1/14 each.

"Introduction to Science" - Prof. J. Thomson

"Matter and Energy" - F. Soddy

"Chemistry" R. Meldola

"Plant Life" - J. B. Farmer

~~The Origin & nature of Life~~

"Astronomy" - A. R. Hinks

The Making of the Earth - J. W. Gregory

peoples books.

A. Glover on education

1.

Consider science as a knowledge of methods of using physical powers (causation of events in space time).

This course is not to conflict with Indian culture but rather to be an enrichment of minds & material environment.

Enlarge the introduction by quotations from various scientists. Also from book on language. References also to relativity.

Insert a list of apparatus. Include measure

A list of inexpensive text books for use of teache

Indicate to how great an extent it can be do by oral teaching.

Think out & insert further details re transition of first part to discussion & treatment of radiant solar energy. Reflection

Another kind of order is one of materials. E.g. metal (Cu, Fe, Mn, Al, Ag, Au, Pb), cloth (cotton, silk wool, linen), leather (cow, goat, sheep), wood (teak, pine, ela clay (coarse & fine), glass, gums, grains, solids liquids

Changes in Moon, sun.

Urdu word for structure = banāwat

Whitehead points out, in his "Science & the Modern World" that before science developed in Europe there grew an instinctive sense of law & order based on the concept of a personal, responsible, causative God; and a general interest in Nature & the objective world, during the Renaissance. These were part of the general "mental climate". Also the spirit of curiosity, wonder, adventure & search was abroad, stimulated greatly by the discoveries of the ~~New World~~ navigators like Columbus, etc.

In India the concept of Karma gives a sense of law & causation. Apply this to external world. The objective interest in nature is largely absent but will have to be replaced by a growth in sense of unity of all things with man, the

immanence of spirit. These two differences will presumably give a different orientation to science, which, ~~by it~~ after it has attained to maturity, ought to supplement & correct & stimulate Western Sci. greatly. The latter through the latest developments in physics (Relativity — Whitehead's concept of organism) is now better prepared to meet an Oriental science.

Most of the "nature study" courses are designed to discipline and ~~—~~ put order & connection into this interest in objective nature.

Have exercises in criticism & probability so as to develop sense of accuracy, objective truth, truth of statement, and critical faculties.

If the root of a number cannot be exactly obtained, the root is called a surd or an irrational number.

For Geometry use either

Pierpont or

S.N. Das Gupta - "Demonstration Geometry for Matriculation Candidates"; Atma Ram & Sons. Lahore 1926

½ for theorem & problem

⅓ for riders or deductions

150 total marks, of these 75 marks are

algebra 35

arith 40

geometry 75

of these 75 geom pts, 50 pts are demonstrations, 25 pts are riders, or deductions or exercises

10 Lect the exercises for each theorem

For Algebra use either Rose or Hall & Knight Elementary algebra Macmillan 1909 w. answers

For Arithmetic Taj Ram